



वार्षिक प्रतिवेदन Annual Report 2000-2001



उत्तर पूर्वी पर्वतीय अनुसंधान परिसर (भारतीय कृषि अनुसंधान परिषद) उमियम-७९३ १०३, मेघालय

ICAR Research Complex for N.E.H. Region (Indian Council of Agricultural Research) Umiam-793 103, Meghalaya



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Published by

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Designed & Printed by

Mystical Graphics, B 62/13, First Floor, Naraina Industrial Area, Phase-II, New Delhi-110 028 Tel.: (O) 5707869, (R) 5136749 (M) 9810159587

CONTENTS

1.	Executive Summary	1
2.	Introduction	6
3.	Research Achievements	12
	• Weather	12
	• Rice	13
	• Maize	19
	• Pulses	23
	• Oilseeds	26
	Cropping System Research	29
	Millets Biofertilizer	30
	• Mushroom	30
	• Fruits	31
	• Vegetables	35
	• Spices	38
	Pasture and Fodder Production	39
	• Pig	40
	• Rabbit	44
	• Cattle and Goat	46
	• Dairy • Fish	50
	• Poultry	51 52
	• Rodent	54
	Agricultural Engineering	55
	Agricultural Economics and Statistics	56
	Transfer of Technology	56
	• Farming System Research	58
	Agroforestry	64
	• Visitors	67
4.	Publications	69
5.	Manipur	74
6.	Mizoram	91
7.	Nagaland	101
8.	Sikkim	108
9.	Tripura	118
	. Scientific, Technical and Administrative Staff	136
	Scientific, Technical and Administrative Staff of KVK/TTC	148
	. Hindi Version	150
4	THIRD VELOCITY	150

PREFACE

The annual report is the image of an Institution reflected through its research and developmental activities. It also suggests the researchers to chalk out the future strategies, based on the results achieved during the past years. ICAR Research Complex for NEH Region has completed more than 25 years and has been endeavoring for the betterment of the farmers by improving productivity of major crops and livestock through research and extension activities. The Institute has 92 projects of different disciplines during the period under report and there are a varying number of experiments in each project. Certainly there have been salient findings/notable achievements that are being made operational to meet the increasing demand.

This report covers the research results achieved during the period from April 2000 to March 2001. The Complex has all the disciplines of agriculture and allied sciences; therefore, cropwise and livestockwise results have been compiled. The report of each centre has been kept under the name of that State. To have a birds' eye view of the work done, executive summary of each centre as well as main complex has been incorporated.

The Complex has made all round progress including evolving of the new varieties of rice and tomato during the period under report. Many villages have been adopted to transfer the technology through extension activities so that the technology may reach to the threshold of the farmers. A number of Kisan Melas, Field Days, exhibitions, etc. were organized for the benefit of farmers yet a lot has to be done to reap the fruits of the technology generated by research. A number of research papers were published and presented by the scientists of the Complex in National/International seminars, symposia and workshops.

I highly acknowledge the cooperation and support rendered by Dr. B.P. Bhatt, Dr. D.K. Verma, Mrs. Rajeshwari Shome, Mr. H.C. Joshi, and Er. R.K.P. Singh and Mr. Ajeet Khound to collate, compile and edit this report.

Umiam

Dated: 25.01.2002

(N.D. Verma)

1

EXECUTIVE SUMMARY

Total rainfall received during 2000 was 2652.6mm, distributed over 190 days. It was 500mm more than last year and about 300 mm more than normal annual rainfall. Rain occurred almost every month ranging from 3.1mm (Feb.) to 656mm (June). More than 80% of rainfall received during June to October. Mean monthly minimum temperature ranged from 5.4°C (January) to 20.5°C (July), while the maximum temperature varied from 18.3°C (January) to 27.3°C (August). Evaporation was found highest in the month of April (154.0 mm) and lowest in January (68.4 mm). Relative humidity was highest in June (91%) and lowest in December (62%). The sunshine hour ranged from 1.80 hr/ day in August to 7.2 in February and March.

In a study on upland rice cultivar under rainfed conditions, the rice cv. RCPL-1-28 produced the highest yield of 44.16 q/ha, followed by RCPL-1-27 (37.71 q/ha). The highest rice grain yield of 32.4 q/ha was recorded in manually tilled plots and the lowest 26.3 q/ha in zero tilled plots. The results also indicated that the application of fresh jungle grass or Ambrosia sp @ 5 t/ha was more effective than FYM (5t/ha) towards the grain yield production.

In the International Upland Rice Observation Nursery (IURON-2000), a total of 53 genotypes with international and local checks were evaluated. Highest yield was recorded in WAB 224-16-HB (47.55 q/ha). In the screening trials, 13 lines were advanced from \mathbf{F}_4 to \mathbf{F}_5 based on their yield, maturity, number of effective tillers and plant height, and six \mathbf{F}_2 populations were advanced to \mathbf{F}_3 .

Under mid altitude lowland trial, 140 rice germplasm were evaluated in lowland with 5 check varieties each *viz*. Ngoba, Take, RCPL 1-87-8, RCPL-1-87-4 and RCPL 1-4 in augmented design for their morpho qualitative and biometrical traits.

In high altitude yield trials, NEH Megha Rice 2 was the best variety for high altitude areas under late sown conditions.

In an experiment to assess the yield performance of high yielding rice cv. RCPL 1-3, it was found that crop applied with FYM @ 5 t/ ha + 60 kg N + 25 kg Zn So₄/ ha produced highest grain yield (39.5 q/ha), followed by the treatments- 2.5t FYM/ha + 60kg N + 25kg ZnSO₄ (36.9 q/ha) and FYM 5 t/ha + 30kg N + ZnSO₄ @ 25 kg/ha (36.1 q/ha).

Under the technology development for efficient nutrient management in lowland rice, the highest grain yield (40.7 q/ha) of rice cv. RCPL-1-87-8 was with FYM applied @ 5t/ha+Azolla+ 75 and/or 100 per cent of the recommended dose of NPK.

Upland rice varieties RCPL-1-24, RCPL-1-25 and RCPL-1-29 can be cultivated successfully in guava based and Assam lemon based agrihorticulture agroforestry systems. Khasi mandarin (*Citrus reticulata* Blanco) should be planted in agroforestry systems with a maximum plant density of 400/ha to obtain sustainable yield.

The blast disease incidence was less in plots sown in early dates as compared to late sown plots (12th June). Crop sown on 5th May had 60% foliar blast, whereas, 88% disease was observed in crop sown on 12th June. The blast disease was

less in IRAT 144 (15%). The occurrence of brown spot was more in middle sown crops. The incidence was maximum (35.55%) in 24th May sown crop.

Under integrated disease management of rice diseases in upland conditions, three rice varieties were evaluated against blast and brown spot and it was found that the incidence of blast was (86.42%) on HR 12 in control plots and spraying of *Bavistin* reduced the disease considerably (44.94%). The severity of brown spot was more in IET 13459 (76.29%). In chemical control of blast through fungicides, *Hinosan* reduced the incidence of blast (6.17%), followed by KTU 3616 (12.84%).

176 entries were screened against rice blast and among NSN-1 trials, 133 lines showed resistant to moderately resistant reaction against blast.

Discolouration of rice grains is becoming a major problem in some varieties of rice both in upland and lowland conditions. Out of the cultivars tested, IRAT 246 showed the maximum discoloured grains/panicles, followed by IRAT 144. The grain discolouration was less in plots sprayed with 0.05% *Carbendazim*.

Gundhibug was found highly attracted to decaying crabs, fish and other animal proteins. Among them decaying crabs were found to be most effective. Pheromone traps were modified and crabs were placed in place of pheromone and placed during flowering to grain maturity in rice fields. Each trap collected 120-135 gundhibugs per day during peak infestation.

In order to increase maize productivity in rainfed agroecosystem of hills, efforts were continued to develop high yielding, short duration, yellow flint hybrids and composites possessing resistance to *H. turcicum* leaf blight.

In the coordinated trials, DMR 252, DMR 124, DMR 103, DMR 223, DMR 113, DMR 49 and DMR 130 were the top performing entries, whereas, in NEH trials SW and DMR- 91-145-1 have topped the performance by giving 60.72q/

ha. In ET-17 (CIMMYT-2000) POP-903.C.2 has topped in the performance by giving a yield of 63.34 q/ha. In RCRT, Vijaya has ranked first. As diversification of maize crops suitable for popcorn, RCM-75 (38.81 q/ha) and RCM-76 (35.52 q/ha) were found promising. For baby corn RCBC-4 and RCBC-9 has given 32.33q/ha and 31.92 q/ha of baby corn yield, respectively.

Breeder seeds of RCM 1-1 (95 kg), RCM 1-2 (80 kg), RCM 1-3 (150 kg), RCM 1-4 (10 kg), OCM-2 (50 kg), Coix (6kg) were produced by maintaining rime and/or distance isolation for further production of breeder seeds during *kharif* 2001.

The grain and straw yield of maize and mustard increased significantly with the application of N, S and pig manure.

Response of rainfed maize under different method of sowing to nitrogen showed that increasing levels of nitrogen up to 120 kg/ha increased the maize grain yield significantly (33.83 q/ha), followed by application of 90 kg N/ha. Ridge method of sowing gave maximum yield (28.11 q/ha), followed by plain sowing and boon system of sowing.

Maize cob borer was found as the major pest infesting maize. Early sown (first week of April) crop was suffered least by this pest. Application of carbofuran 3G @ 1 kg a.i./ha at sowing gave good control against pod borer and foliage pests.

Groundnut variety TG-26 exhibited the highest pod yield (26.25 q/ha), followed by TAG-24. Application of RP @ 50 kg P2O5/ha resulted in significant increase in pod yield of groundnut (27.58 q/ha), shelling percentage (79.5), P and S uptake (7.3 and 5.4 kg/ha, respectively) by kernels. In acid soils, the pod yield of groundnut increased significantly with the application of sulphur, boron and FYM.

Out of six black gram genotypes evaluated during the period, higher root length was observed in TPU-4 (19.5 cm), followed by TAU-1 (16.9 cm). While in green gram, highest seed yield (8.7 g/ha) was found in TM-97-25, followed

less in IRAT 144 (15%). The occurrence of brown spot was more in middle sown crops. The incidence was maximum (35.55%) in 24th May sown crop.

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by TM-96-2 (7.7 q/ha). It was seen that effect of sowing has its own impact on grain yield. A higher grain yield was produced, irrespective of the variety when sowing was done in the first week of August.

In an experiment of weed control under non-cropped/abandoned land, Galinsoga parviflora was recorded as most dominant weed, followed by Bidens pilosa and Ageratum conyzoides. In monocot weeds, Digitaria sp. was the most competitive one. Under upland rice condition, Cyperus iria was the most dominant weed. However, among various herbicides, rice guard was found most promising to control the weed flora of transplanted low land rice.

In rice-bean out of 8 varieties tested, RCRT, RCRB 6-10, EC 2074 and EC-1667 were the highest yielder with a yield of 9.14, 8.47 and 7.11 q/ha, respectively.

In mungbean advanced varietal trial, ACT were conducted during *kharif* and out of a total of 29 entries, varieties 99M-39 (8.11 q/ha), 99 M-13 (5.01 q/ha) and 99M-11 (4.76 q/ha) gave maximum yield with a trial mean of 1.89 q/ha.

Fifty-four varieties were evaluated in *kharif* in 3 trials (AVT, IVT and BARC), wherein DPU-91-7 (3.81 q/ha), 99 U-26 (4.98 q/ha), 99 U-46 (4.60 q/ha), TAU-2 (6.05 q/ha), TU-96-1 (5.42 q/ha) and TPU-4 (5.35 q/ha) were top yielder in different trials.

In oilseeds, 8 off types of groundnut selected from JL-24 were made and JL 24/98-8 (26.56 q/ha), JL-24/98-1 (23.99 q/h) and JL-24/98-11 (22.15 q/ha) were top ranking. One hundred lines were evaluated for screening in acid upland. These lines showed an average yield of 5.38 q/ha and ICG-6663 gave maximum yield of 13.67 q/ha, followed by ICG-6697 (11.77 q/ha).

In soybean, out of 41 varieties evaluated under AVT, JS (SH) 89-48 yielded highest pod, *i.e.*, 22.88 q/ha, followed by NRC-18, which gave 21.66 g/ha.

In groundnut, out of 100 genotypes screened under natural epiphytotic condition during rainy season only 16 entries showed moderate level of resistance against early leaf spot diseases.

The highest number of beetles in mustard was found 50/ sq.m. During the flowering season and during the harvest their activity was very high (200 beetles/sq. m), which indicated their use in biological control. Hexaconazole was most effective in reducing rust and angular leaf spot severity and yield increase.

Among rhizomatous crops, rhizome yield of ginger increased significantly with increasing levels of N and FYM application. Application of rock phosphate @ $100 \text{kg P}_2 \text{O}_5$ /ha in conjunction with FYM resulted in maximum fresh rhizome yield (25.58 t/ha).

There was significant increase in the yield of garlic with increasing levels of P and S and a synergistic relationship was found between P and S for bulb yield of garlic and nutrient uptake.

Bamboo dust, a waste from paper mills was tested for growing oyster mushrooms by polybag method and it was found that *P. citrinopileatus* could be successfully grown on bamboo dust with 81% biological efficiency and it is concluded that the bamboo dust can be successfully utilized for Oyster mushroom cultivation.

The infection of pea aphid by fungi *Erinium neoaphidis* increased with the increase in sunshine hrs. of the winter season and dry cool weather. Parasitization of *A. pisum* by hymenopteran wasps was found effective to a greater extent to control aphids.

The rodent activity was highest in August to October and lowest in February. The highest numbers of active burrows were recorded in upland cultivated areas. Like previous years Bandicota bengalensis was recorded as predominant species in fields as well as in urban areas. Use of anticoagulants was found very effective for rat control in houses, shops and Godowns in urban areas. Racumin and difethialone baits were consumed at par and effective control was achieved within 10 days after 2 days poison baiting.

In isoenzyme analysis conducted for two enzyme viz. Glutamate Oxaloacetate Transminase (GOT) and Esterase (EST) utilizing leaf samples collected from micro propagation, micro grafting and nucellar mother plants of

Khasi mandarin (Citrus reticulata Blanco) using polyacrylamide gel electrophoresis confirmed that all the plants were genetically pure.

In softwood grafting of *Khasi* mandarin, maximum plant height (32.14cm), length of scion (21.60cm), diameter of scion (13.82mm), number of leaves (15.20 leaves/plant) and spread (16 x 11 cm²) were found in Pumelo used as rootstock, however, number of branches were found to be highest in *Citrus latipes*. Out of the seventeen *Citrus* species scored for the various diseases during the season, the intensity of *Alternaria* leaf spot was particularly more on rough lemon.

Paclobutrazol at 150 mg/l was found the best treatment for increasing the yield of French bean variety Meghalaya local by suppressing the vegetative growth and enhancing the flowering and fruiting.

Four promising selections of tomato sowing tolerance to late blight and wilt disease were selected/identified from the progeny of F₂ population.

In hill and mountain agroecosystems, agroforestry plays a vital role as far as natural resource based farming is concerned. Parkia roxburghii and Alnus nepalensis has been found fast growing tree species as compared to other multipurpose tree species. These species also have great potential to restore jhum degraded/ fallow lands. However, plant density should not exceed more than 400/ha, to obtain sustain yield of food crops in combination of tree-crops. Broom grass (Thysanolaena maxima) can be cultivated as hedgerows in different agroforestry systems for soil conservation measures. In Som (Machilus bombycina) based system, congo, guinea and broom grass can be cultivated in 1:1:1 ratio for optimum production of forage.

The economics of potential agroforestry systems (AFS) consisting of mandarin and guava in combination with different crop rotations were worked out. The NPV, BC, IRR were computed for financial analysis. The per ha cost of planting, mandarin based AFS was worked out to be Rs. 31,210 for soybean, Rs. 32,877 for grouter than the state of the s

ndnut, Rs. 45,627 for turmeric and Rs. 44,745 for ginger and same for guava based AFS.

Under mandarin based AFS, all the systems were profitable at 18% discount rate. Mandarin + ginger + french bean system was worked out to be the most profitable with benefit cost ratio of 2.58, followed by mandarin + turmeric + French bean (2.54). In case of guava based AFS, Guava+ginger+ frenchbean was found to be the most profitable.

The share of agriculture in net domestic product NDP is higher in NE states except Nagaland than that for all India level. The decline in the share of agriculture in NDP is higher than the decline in labour force in agriculture. The area put to agricultural use was significantly low in NE states compared to all India level of 46.73%. It was highest in Tripura (22.90%) and lowest in Arunachal Pradesh (2.04%).

Runoff plot studies for estimation of USLE input parameters were undertaken and runoff production behaviour was recorded and analyzed. The study revealed that in early stages of ginger on bun produced maximum runoff and soil loss while after development of full canopy of the crop, the runoff production and soil loss were reduced.

Farm mechanization survey was conducted in 64 villages to study the status of use of farm machinery and the traditional methods of manufacturing these tools were also studied to identify gaps and to identify the farm machines suitable for existing cropping systems. A local bamboo-cone device to harvest oranges was modified by using steel wire and mild steel pipes instead of bamboo strips. The harvesting rate is about 300 fruits/man/hour with 4-6% damage.

Fabrication of 500 nos (200 tubular and 300 octagonal) of maize shellers, 50 nos of PAU design hand wheel hoe and 10 numbers of *Citrus* harvesters have been completed.

The various need-based technologies were transferred through different means like Verification Trial (VT), On-Farm Trial (OFT), OnFarm Research (OFR) and Institute Village Linkage Programme (IVLP). During 2000-2001, a total of 17 interventions have been covered in 13 villages among 1000 families.

Productive performance of 30 local pigs (*Khasi* local) procured from different villages and their F_1 generation was studied. 44 farrowing from 30 F_1 generation produced by crossing indigenous pig with Hampshire breed were also studied.

A study on the major causes of piglet mortality in the previous reports had revealed Salmonellosis and Colibacillosis as important infections and a detailed study on the pathogenic processes of these organisms is being investigated. The studies on major virulence factors viz., enterotoxigenicity and plasmid profile of E. coli and Salmonella were studied.

Cysticercus cellulosae infection was found in 6.2% of pigs, out of 225 pigs tested and 4% of pigs had hydatid cyst infection. Similarly out of 210 cattle's and 315 goats tested, 10.9% and 3.5% had hydatid cyst infection, respectively. Computer software had also been developed encompassing the information of different parasites, life cycle, pathogenesis and treatment in various species of animals.

Productive and reproductive traits of pure breed rabbits such as New Zealand White and Soviet Chinchila and locals are studied apart from 6 genetic groups obtained through diallel crossing involving all these breeds. Different studies were undertaken in rabbit's revealed bordetellosis as an emerging new threat responsible for respiratory affections.

Considering the high consumption rate of beef and pork in the region, a study was undertaken to gauge the bacterial quality of meat sold in Meghalaya. High bacterial counts were observed in majority of the samples, which included the presence of bacteria having potential of causing food poisoning and food bome infections in the population. In addition to the work carried out in the specific projects, disease diagnostic and advisory services were

provided to the State Government and farmers.

Incubation of feed with live yeast culture for 48 hours at 37°C increased the protein content of feed from 3.33% to 10.53%. Rice polish up to 75% in pig ration with Soya meal as source of protein did not show any adverse effects in pigs. Whereas, groundnut fodder meal at the rate of 10% level was found suitable for feeding broiler chicken.

Among probiotic preparations tried, anizyme was found superior than allzyme preparation in poultry birds. Grazing of commercial broiler birds or feeding groundnut fodder did not show any beneficial impact in growth rate. Likewise, *Makri sal* leaves were not found suitable for feeding goats.

Prostaglandin F₂ Alfa (Illirin) given in cows 6 hours after parturition, showed proper involution of uterus without signs of retention of placenta, endometritis, metritis, mastitis, prolpse of cervix or uterus and onset of estrous after parturition was found less than hard average.

The warm water fish Labeo gonius (Hamilton) was successfully bred in cold water (19.0-21.0°C) also at high altitude condition (900 m asl). The commercial fishery in Umiam reservoir was found to be dominated by Cyprinus carpio var. communis (54.84%). The chocolate mahseer, Neolissocheilus hexagonolepis (Mc Clelland) is a threatened species in Umiam reservoir and was found to contribute only 1.12% to the total catch in this reservoir. The zebra danio (Brachydanio rerio Hamilton) and the moustache danio (Danio dangila Hamilton) were found to possess ornamental characters like small size, beautiful colour and attractive bands. They are non-aggressive, compatible and respond to artificial diets. The Brachydanio rerio was found to be a prolific breeding. The relative fecundity was high ranging from 1075.00 to 2560.42.

2 INTRODUCTION

ICAR Research Complex for NEH Region has completed more than 25 years in the service of tribal farmers. The Complex was established in 1975 under the aegis of ICAR- New Delhi, an apex body for the agricultural research in India, with its Head Quarter at Shillong, which was shifted to its actual site at Umiam (Barapani) in 1991. It is unique in the respect that all the disciplines of agriculture, horticulture, animal science, farming systems research, agroforestry and agricultural engineering are at the same platform to accomplish the overall development of the farmers through multidisciplinary approach.

The Complex has six centers, i.e., one for each hilly state of entire region, located at Lembucherra (Tripura), Kolasib (Mizoram), Imphal (Manipur), Basar (Arunachal Pradesh) and Tadong (Sikkim) with its Head Quarter at Umiam (Meghalaya), to generate the technology for different agroclimatic zones of the entire region. Six Krishi Vigyan Kendras (KVKs) are functional to disseminate and broadcast the technology among farmers, generated through research. One TTC (Trainers' Training Centre) is also organising trainings for the officers of State Govt. Organization/ NGO's, etc. so that a network could be made to train the farmers as well as trainers also. While selecting the sites for different States, the entire NEH region has been considered as one unit and research centres are so located as to represent the varying altitudes and agroclimatic zones of the region. This has helped in rational utilisation of scientists avoiding duplication of work and the total outcome of the research at different centres could

thus be utilised for specific latitudinal range and agroclmatic zones of all states.

The Main Complex is located at Umiam about 22 km away from Shillong nearby the Umiam lake, which is the major source of power for entire State of Meghalaya. The latitude and longitude of the place are 25°30' N and 91°15'E. The 101 ha farm has mild to steep slope and flat valleys, which provide suitable site for almost all kinds of agricultural research for hilly topography. Bench terracing on mild slope and contour bunds and half moon terraces on steep hills have been developed for conservation of soil and water resources. Trenches and earthen dams have also been made to harvest the runoff water. At present, the area under cultivation is around 60 ha.

THRUST AREAS

- To evolve sustainable integrated farming systems for the hills of the region to replace jhum (shifting cultivation) for increased productivity.
- Restoration of degraded/jhum fallow lands through tree based farming.
- Development of feed and fodder's resources including local fodders for different livestock.
- Improvement of Citrus plantation to rejuvenate the Citrus industry.
- To increase the overall productivity of different crops through research in cereals, pulses, oil seeds, horticultural and other economic crops.
- Animal health coverage and improvement of livestock production system.

MANDATE OF THE COMPLEX

- To undertake the basic and applied research for delivering technologies based on sustainable farming system for different agroclimatic and socio-economic condition of the region.
- To improve the productivity of the crops, livestock, and fishery.
- To act as a repository of information on natural resources, different farming and land use systems of the region.
- To provide training in (i) research methodology and (ii) use and application of improved technologies for enhancing agricultural productivity.
- To collaborate with the State Departments for the agricultural development in the region, and testing and promotion of improved farming and land use technologies.
- To collaborate with National and International agencies in achieving the aforesaid objectives.
- To provide consultancy.

NATP Projects

During 200-2001 a total of 29 projects were in operation under National Agriculture Technology Projects with a total expenditure of 90.6 lacs.

Strength and Man Power

The Institute has 15 different disciplines *viz*. Plant Breeding, Agronomy, Soil Science, Plant Pathology, Entomology, Agroforestry, Agricultural Economics and Statistics, Agricultural Engineering, Agricultural Extension, Horticulture, Animal Health, Veterinary Parasitology, Animal Nutrition, Animal Production and Fishery. At present there are more than six dozens ongoing research projects in the Institute. The institute, headed by the Director has a total number of 607 (excluding KVKs and TTC) staff in position. The staff position of the Institute is presented below:

Category	Sanctioned	Filled	Vacant
Scientific	192	112	80
Technical	318	248	70
Administrative	154	113	41
Supporting	136	134	2

Library

The Institute has established a sophisticated agricultural research library, which has acquired so far 16,346 books and reports and 11,015 back issues of several publications. It has subscribed 42 foreign and 122 Indian journals. The library has been providing good services to the scientists and other categories of users visiting the library regularly.

Computer Facilities

The Institute has a rich computer database of library resources. It is also providing computerised database on Environmental Degradation in Northeast India by scanning six regional and national newspapers. Library is connected with NICNET, and rendering *Selective Dissemination of Information Services* to its scientists by accessing the International Data Base available with IASRI, New Delhi including E-mail services. Internet Services are also being provided by ARIS Cell of the Complex. A website has been developed depicting update staff position and important information/publications.

Budget

The budget of the institute for the year 2000-2001 is given below:

(Rs. in Lakhs)

Budget	Alloted	Expenditure	
Plan	337.00	319.82	
Non-plan	1226.00	1142.27	

Linkages

The institute regularly providing advisory services to the department of Agriculture and allied sectors. Biennial interface meetings are held at the institute to discuss various problems of agriculture and related matters for research and development with Department of Agriculture, Government of Meghalaya and scientists of various disciplines. The information generated through research is passed on to the farmers through publication of Books, Newsletters, Annual Reports and Technical Bulletins.

Staff Research Council Meeting

Staff Research Council Meeting of ICAR Research Complex was held during 24-25th June, 2000 at Umiam, which was graced by DDG (NRM) Dr. G.B. Singh. The meeting was attended by all the Joint Directors and Head of Divisions/ Sections.

Interface Meeting

Interface meeting between the scientists of ICAR Complex, Umiam and the officials from the Department of Agriculture, Govt. of Meghalaya was held on 19-20 September, 2000. Issues on various problems of agriculture, horticulture and agroforestry were discussed and joint programmes were chalked out. A core group of researchers, drawn both from the Complex and the State Department was formed to look into various problems of agriculture in Meghalaya.

An Interface meeting between ICAR and State Animal Husbandry and Veterinary and Fisheries department, Govt. of Meghalaya was held on 23rd October, 2000 to discuss the various problems related to livestock and fishery production and to discuss about the possible remedial measures. There was in-depth and lively discussion on many problems of livestock as well as fish production. The discussion on problem of aflatoxicosis and goat mortality in Meghalaya was discussed in detail and a working group was formed to overcome this situation.

Research Advisory Committee Meeting

A two days meeting of Research Advisory Committee (RAC) was held from 17th-19th January



RAC Meeting at ICAR Complex



Sh. E.K. Mawlong, Hon'ble Chief Minister of Meghalaya addressing the farmers at Kisan Mela

2001 under the chairmanship of Dr. K.G. Tejwani. The RAC suggested a "MISSION GOAL" for the Research Complex as "To develop technologies, which achieve self sufficient agricultural production through sustainable and resource conserving farming systems". The RAC reviewed the research achievements of the Institute and its centres and recorded:

- considering the man-power available, the constraints of remoteness, as well as unsettled conditions in some states, the RAC is satisfied with respect to the range of experiments laid out and projects undertaken and wishes to compliment the scientists for their enthusiasm and commitment,
- achievements should articulate the technology developed or any specific contribution to technology developed, and
- observations or studies undertaken should not be reported as achievements/outputs, unless it is specifically articulated that they will/may lead to solution of a problem or develop-ment of a technology.

Kisan Mela Organized at Umiam

A Kisan Mela was organised on 16th September, 2000, which was inaugurated by Sh. E.K. Mawlong, Hon'ble Chief Minister, Govt. of Meghalaya. While addressing a mammoth gathering of farmers, he urged upon the state

officials to come closer to ICAR in taking up the developed technologies in the farmer's field. This was the 2nd Kisan Mela by ICAR Complex in its Silver Jubilee year. More than 500 farmers from thirteen villages adopted under IVLP and FLD on Maize participated in it. Sh. Mawlong also handed over checks of Rs. 440/- to 151 farmers of Ri-Bhoi district who were adopted under FLD programme on maize. Shri B.K. Sangma, Hon'ble State Minister for Agriculture, Govt. of Meghalaya lauded the efforts of ICAR Complex to improve the condition of tribal people.

Kisan Mela at Basar and Zonal Kisan Mela at Roing

Shri Tako Dabi, Hon'ble Agriculture Minister of Arunachal Pradesh inaugurated a two days Kisan Mela at Gori Research Farm on 18th and 19th October, 2000 to mark the celebration of the Silver Jubilee year of the Basar Centre of ICAR Complex for NEH Region. On this occasion Shri Eken Riba, Hon'ble Minister of State Law, Justice and Parliamentary Affairs and Shri D.Y. Perme, Agriculture Secretary were also present.

A Zonal Kisan Mela for the farmers of five districts of Arunachal Pradesh was organised on 23rd December, 2000 which was inaugurated by Shri Mukut Mithi, the Hon'ble Chief Minister of Arunachal Pradesh. He emphasized the need of early formulation of State Agriculture Policy

Document with a greater emphasis on marketing and processing infrastructure. Shri Tako Dabi, Hon'ble Agriculture Minister and Minister of Public Works Department also graced the occasion.

Workshop on Citrus Decline

ICAR Research Complex for NEH Region, Umiam and NRC on *Citrus*, Nagpur jointly organised a two days workshop on *Citrus Decline* and Management in NEH Region during 4-5th September 2000. The inaugural function was presided over by Dr. S.S. Ghosh, D.D.G. (Hort.), ICAR Head Quarter. Dr. G.L. Kaul, Vice-Chancellor, Assam Agricultural University, Jorhat was the chief guest on the occasion and Dr S.S. Baghel, VC, CAU, Imphal was the guest of honour.

Tomato Varieties Released

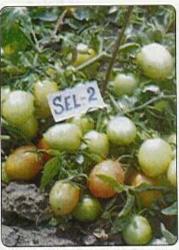
Three varieties of tomato- Manikhamnu, Manileima and Manithoib developed at Manipur Centre were released by State Variety Release Commitee. His Excellency, Sri Ved Marwah, the Governor of Manipur released these varieties in a Kisan Mela, organized by ICAR Manipur Centre on 20th October, 2001 as a mark of Silver Jubilee



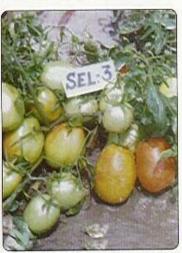
Workshop on Citrus decline and management in NEH Region



Variety - Manikhamnu



Variety - Manileima



Variety - Manithoib

year of the ICAR Complex for NEH Region in the presence of Sh. S. Rajan Singh, Hon'ble Minister of Agriculture and Sri A. Biren Singh Hon'ble State Agriculture Minister, Govt. of Manipur.

Jai Vigyan National Science and Technology Mission on "Household Food and Nutritional Security"

In its Silver Jubilee year, ICAR Complex launched "Jai Vigyan NST Mission on House Hold Food and Nutritional Security" on 22nd July, 2000 at Umsaw village of Ri-Bhoi district, which was inaugurated by Sh. E.K. Mawlong, Hon'ble Chief Minister of Meghalaya. He also distributed 24 piglets and feed to the selected farm families on this occasion.

Farmer's Hostel at Tura

Mr. K.C. Momin, Hon'ble Minister of Tourism, Govt. of Meghalaya laid the foundation stone of Farmers Hostel at Krishi Vigyan Kendra, Tura, Meghalaya. Dr. N.D. Verma, the Director of the ICAR Complex for NEH Region, Umiam also inaugurated the Office Building of KVK, Tura in presence of Hon'ble Minister.



Sh. E.K. Mawlong, Hon'ble Chief Minister of Meghalaya inaugurating the Jai Vigyan NST Mission on Household food and Nutritional Security



Foundation stone laying ceremony at KVK, Tura

3 RESEARCH ACHIVEMENTS

WEATHER

K.K. Satapathy and D. Daschaudhuri

Different weather parameters, e.g. air temperature, soil temperature, relative humidity, wind direction, wind speed, evaporation, rainfall, bright sunshine hrs, etc. were recorded daily at 0622, 0830 and 1322 hr, respectively during the year 2000 and the details has been given below:

Air temperature

The mean monthly maximum temperature varied from 18.3°C (January) to 27.3°C (August). July was the hottest month and temperature remained in between 25 to 31°C. Maximum temperature recorded for a single day was highest (31.8°C) on 16th July and lowest (15.8°C) on 2nd February. The temperature gradually increased from January to August then started declining till December.

Mean monthly minimum temperature recorded varied from 5.4°C in the month of January to 20.5°C in the month of July. Mean monthly temperature started rising from February till July and then started declining and recorded lowest in January. Minimum temperature was highest (22°C) on 12th July and lowest (3.5°C) on 5th January.

Soil temperature

Soil temperature in the morning at 30cm soil depth was slightly higher than that at 15cm depth and was reverse in the evening. Soil temperature at 15cm depth varied from 11°C in the month of January to 24.5°C in the month of July. After July, temperature starts falling till January.

Soil temperature at 30 cm depth also followed the same trend and it varied from 13°C (January) to 24°C (July). Mean monthly temperature was highest in the month of July (24°C). There was very little difference of temperature in these two depths. Except the months from June to August temperature at 30cm depth was more than 15cm depth. Soil temperature was always less than the air temperature.

Rainfall and rainy days

Total rainfall received during 2000 at Umiam was 2652.6 mm distributed over 190 days. Yearly rainfall was about 500mm more than last year and about 300mm more than yearly normal rainfall. Total number of rainy days were more than the normal and last year. Rain occurred almost every month of the year ranging from 3.1mm in the month of February to 656mm in the month of June. More than 80% of rainfall received during June to October. There were about 175 days without any rain. Highest amount of rainfall for a single day was recorded on 24th June (112.7mm).

Evaporation

Evaporation was highest in the month of April (154.0mm) and lowest (68.4mm) in January. Evaporation recorded in a single day was highest (10.0) on 6th April and lowest (0.8mm) on 24th June. The total evaporation for

a single week was highest (61.5mm) in 14th week (2nd to 8th) of April. From November to April evaporation was higher than the rainfall but from May to October rainfall was higher than the evaporation. This indicates the water stress in the soil. The total evaporation for this year was 1051mm, which is 40mm more than the previous year and 30mm less than the yearly normal evaporation.

Wind speed and direction

Mean monthly wind velocity had ranged from 2.8 Km/hr in the month of August to 7.8 Km/hr in the month of December. During the rainy season wind was blowing at 2 to 5 km/hr. On an average, wind speed was highest (15.9 km per hr) on 3rd April. Around 26 days average wind speed for a day was above 5km/hr and 6 days above 10km/hr. The wind velocity was not significantly high to pose problems to any crop throughout the year. Wind throughout the year mostly blown from the southeasterly direction. Except April, July to August and November to December wind had blown from the southerly and easterly direction, respectively.

Relative humidity

Relative humidity at 0622 hr at Umiam was highest in the month of June (91%) and the lowest in the month of December (62%). About 66 days, humidity was over 95 per cent. Humidity remained low during December, March and May. Relative humidity in the evening was varying from 36% in the month of December to 79% in the month of June. About 77 days relative humidity was below 55 per cent.

Sunshine hour

The sunshine hour at Umiam had ranged from 1.80 hr/day in the month of August to 7.20hr/day in the month of February and March. From June to October, sunshine hour had ranged from 1.8 to 5.5 hr/day. But from November onwards, sunshine was available for more than 7 hr/day. There were about 50 days where

sunshine was available for more than 9hr/day and about 15 days where sky was overcast throughout the days.



Performance of upland rice in mid altitude

A. Pattanayak and A. Anna Durai

Four yield trials and three screening trials were conducted and seed multiplication of four promising genotypes were taken up under upland condition. In RCRT 13 genotypes were tested with two checks. IR 600-80-32 was the highest yielder (36.21q/ha) while lowest yield was recorded in TRC 87-251 (5.99 q/ha). Other superior genotypes identified in this trial were IR 65907-206-63 (35.80 q/ha), CT 6942-2-9-1-2M (32.80 q/ha), IR 66421-034-2-1-1 (31.06 q/ha) and IR 65907-206-4B (30.26 q/ha). In the Advanced Variety Trial (AVT-UH) only one genotype, IET 16007 showed yield comparable to local check (35.31 q/ha compared to 33.78 q/ha of Bali). In the Initial Variety trial (IVT-UH) IET 16876 (RCPL-35) was the highest yielder (39.59 q/ha) and showed significant superiority over the local check.

In the International Upland Rice Observation Nursery (IURON-2000), a total of 53 genotypes with international and local checks were



IURON Trial at Research Farm

evaluated. Highest yield was recorded in WAB224-16-HB (47.55 q/ha). In the screening trials 13 lines were advanced from F_4 to F_5 based on their yield, maturity, number of effective tillers and plant height and six F_2 populations were advanced to F_4 .

Performance of lowland rice in mid altitude

A. Anna Durai and A. Pattanayk

Eight yield trials (two RCRT, 4 AVT, 1 IET and 1 IURON and one germplasm trial were conducted in the lowland. In RCRT-LL, 13 genotypes were evaluated against the checks; highest yield was recorded in RCPL-1-230 (63.06 q/ha), followed by IRAT 222 (60.90 q/ha). Only the top two genotypes showed more than 5% yield advantage over the better check Ngoba. In RCRT-Aromatic six advanced genotypes, selected from co-ordinated trials, were tested along with three checks. All genotypes viz., IET 16310 (40.35 q/ha), IET 16332 (38.41 q/ha), IET 16309 (33.86 q/ha), Basmati 370 (33.21 q/ha) and IET 16313 (33.06 q/ha) were better than the checks and showed yield advantage ranging from 42.38-73.77% over the highest yielding check Pusa Basmati 1.

In the AVT1-IMH, IET 16470 showed highest yield (47.96 q/ha) and in AVT-EH none of the



A view of AVT (Rice) at Research Farm

genotypes was better than any of the three checks used. In IVT also, test genotypes were not superior to any of the checks. In the AVT aromatic genotypes (AVT1-BT and AVT 2-BT), IET 16310 showed highest yield in AVT2 (44.59 q/ha), while the check variety Basmati 370 was the best in AVT 1. In IURON-2000, ninety genotypes with 2 local checks and 3 internation-al checks were tested. The top three genotypes (TOX3055-10-1-1-1-2, CT9846-1-7-1-1-2P-M and CNAX4354-2-3-1-2-B) showed significantly higher yield than the local checks while the yield of other two genotypes were significantly higher than the local check RCPL1-87-8.

140 rice germplasm were evaluated in lowland with 5 check varieties each viz. Ngoba, Take, RCPL 1-87-8, RCPL 1-87-4 and RCPL 1-4 in augmented design for their morphoqualitative and biometrical traits.

Hybridization

Fifty new crosses of rice involving 15 genotypes *viz.*, (1) IR 61979-138-1-3-2-2, (2) 8470-22-13-4P, (3) DR 92, (5) H 274-(6) UPR1425-14-2, (7) IET 16470 (8) Ngoba, (9) Manipur, (10) RCPL 1-87-8 (11) IET 16451, (12) IET 16470, (13) IET 15482, (14) IET 16051 and (15) B 2983-SB-85-3-2-4M, were effected in line x tester mating design.

On-farm Trials

A total of 22 on-farm trials were conducted with three upland genotypes (RCPL-29, RCPL-28 and RCPL 1-24) two lowland genotypes (RCPL-1-87-4 and RCPL 1-87-8) and two aromatic genotypes (IET 15630 and 15631).

High altitude rice yield trials

A. Pattanayak and A. Anna Durai

Two advanced varietal trials, one AVT-Japonica and another with advanced breeding lines with two dates of sowing and one IYT were conducted. In the AVT-Japonica trial although the check variety NEH Megha Rice 2 yielded highest (14.78 q/ha), but it did not qualify in the quality analysis. Only three genotypes, IET 16114, IET 16923 and IET 16926 (RCPL 1-41) possessed typical Japonica characters. Among these the first two failed to flower under Upper Shillong condition. Mean yield of the trial was very low as the sowing was delayed due to late arrival of seeds. In the initial yield trial highest yield was recorded in F8-5-3P-7-3. In the advanced variety trial (AVT-1) with two dates of sowing RCPL1-41 was the best for normal sowing (first week of May) while NEH Megha Rice 2 was best for late sowing. In the AVT 2, 1F8-5-3P-5-1 was highest yielding under normal sowing, whereas the check variety NEH Megha Rice 2 was the highest yielding under late sowing. The results had suggested that NEH Megha Rice 2 is the best variety for high altitude areas under late sown condition.

Biotechnology

A. Pattanayak, Alpana Das, B. Bhattacharjee and Anil Kumar

Development of insect resistant transgenic plants by introduction of a modified delta endotoxin gene of *Bacillus thuringiensis*

Agrobacterium tumefaciens-mediated transformation of embryogenic callus of rice: In an experiment, embryogenic calli of Japonica rice lines, RCPL 1-2C, RCPL 1-3C and Indica line IR36 were used as target tissue for Agrobacteriummediated gene transfer. Agrobacterium tumefaciens strain EHA105 harboring a binary vector contained synthetic crylA(c), hygromycin phosphotransferase (hph) and gus-gfp fusion genes. Calli were co-cultivated with Agrobacterium tumefaciens in presence of acetosyringon (100µM) and selected on hygromycin (50 mg/l). Calli that survived two selections of 10-12 days each on hygromycin were tested for gus. After three selections, calli were transferred to regeneration medium containing hygromycin (50 mg/l) and kept in dark (28°C) for 15 days. Then they were transferred to light. Twenty hygromycin resistant- gus positive plantlets of IR36, 12 hygromycin resistant- gus positive plantlets of RCPL 1-2C were recovered from two independent transformation experiments. Amplification of cryIA(c) through PCR indicated the presence of cryIA(c).

Agrobacterium-mediated transformation of shoot apices of rice

In order to transform shoot apices of rice using the *Agrobacterium*-mediated transformation, shoot apices of RCPL1-2C, Nami and RCPL1-3C were cocultivated with *Agrobacterium* strain EHA105 containing *cryIA(c)* and *hph* genes. Infected shoot apices were cultured in MS medium containing high concentration of BAP and low concentration of 2,4-D. Both calli and multiple shoots were produced from the base of the infected shoot apices. More than 18% of the shoot apex-derived calli survived 3 selections on hygromycin (50mg/l).

Germplasm collection, maintenance and evaluation

B.K. Sarma, A. Pattanayak, D.K. Verma, A. Anna Durai and J.K. Singh

157 rice germplasm were collected from Champhai, Serchhip and Lunglei districts of Mizoram, West Garo Hills, Ri-Bhoi and East and West Khasi Hills districts of Meghalaya, Majuli river island of Jorhat district of Assam and Basar of Arunachal Pradesh. Most of the germplasm collected from Mizoram and West Garo Hills of Meghalaya were from areas of shifting cultivation. The collections from Ri-Bhoi and West Khasi Hill district of Meghalaya and Arunachal Pradesh were from upland, lowland and hill slopes. The collections from the River Island of Majuli were from lowland and grown in Ahu season. The materials were collected from natural habitat, farmers' stores, and farmers' fields during harvest. The explorations were made under NATP on Plant Biodiversity. Passport data were recorded at the time of collection of each accession. Part of the materials were sent

to National Gene Bank, NBPGR, New Delhi for long term storage and for allocation of IC numbers to each accession. The remaining portion was kept under MTS condition for evaluation and multiplication in the next season. In addition 94 high altitude rice germplasm were maintained at Upper Shillong.

Under upland ecosystem, 196 germplasm were evaluated for twelve characters. Out of 196 germplasm, 110 germplasm were existing and 86 were collected under NATP programme during 1999-2000. The variability observed in different characters are: flag leaf length (20.9- 71.1cm); flag leaf breadth (1.12-3.24cm); leaf number (3-8); tillers number (3.75-12.5); plant height (104.6-166.6cm); panicle length (18.6-34 cm); EBT (3.3-9.6); branches/ panicle (5.2-16.2); panicle weight (3.9-27.3g); 100 seed weight (1.5-3.5g) and yield/plant (0.9-27.3g).

149 rice germplasm of which 90 already existing in the institute and 59 collected under NATP programme during 1999-2000 were evaluated for 11 characters under lowland ecosystems and the extent of variability for different characters were: flag leaf length (19.5 40.6 cm); flag leaf breadth (0.48-1.98cm); leaf number (3.2 -5.8); plant height (73-145.7cm); panicle length (15.6-26.5cm); ear bearing tiller (4-16); branches/panicle (7.6-13.2); panicle weight (0.9-5.7g) and yield/plant (1.1-20.5 g).

Studies on upland rice cultivar under rainfed conditions

S.K. Gupta

The rice cultivar RCPL-1-28 produced the highest yield of 44.16 q/ha, followed by RCPL-1-27 which yielded 37.71 q/ha rice grain. The variety DR-92, which was earlier better variety for upland had yielded the lowest (26.98 q/ha).

Effect of tillage and organics on hydrophysical behaviour of rice soil and crop production under rice based cropping system

V.K. Mishra and S.K. Gupta

The rice grain yield was significantly affected

due to different tillage practices. The highest grain yield of 32.4 q/ha was recorded in manually tilled plots and the lowest 26.3 q/ha in zero tilled plots. The yield under deshi plough and power tilled were obtained 28.5 and 33.1 q/ha, respectively. In case of organic sources, grain yield of control (no grass), jungal grass, Ambrosia sp. and FYM treated plots were, respectively, 26.5, 32.4, 31.2 and 30.2 q/ha. The result also indicated that the application of fresh jungal grass or Ambrosia sp. @ 5 t/ha was more effective than FYM (5 t/ha) towards the grain yield production.

Different tillage practices for puddling brought about considerable reduction in cumulative infiltration as well as infiltration rate over the zero tillage. The cumulative infiltration over a period of one minute was 1.334, 1.081, 1.049 and 0.645 cm for zero, deshi plough, manually and power tiller tilled plots, respectively. For a period of 245 minutes the respective values for the same treatment were 126.0, 84.9, 66.3 and 42.5 cm.

Evaluation of new herbicides to assess effectiveness in transplanted rice

Rajesh Kumar and N.P. Singh

Six different herbicides were used to control the weed flora of transplanted lowland rice. Rice guard was found most promising (43.0 q/ha), which was followed by pyrazosulfuron (40.5 q/ha), and butachlor (40.1 q/ha)

Technology development for efficient nutrient management in lowland rice

A.S. Panwar, D.C. Saxena and U.K. Hazarika

The highest grain yield (40.7q/ha) of rice (RCPL-1-87-8) was with FYM applied @ 5 t/ha + Azolla + 75 and / or 100 per cent of the recommended dose of NPK. The yield recorded due to application of FYM @ 10 t/ha was at par with FYM 5 t/ha + Azospirillum |Azolla in the presence of 100 per cent recommended dose of NPK. It was also observed that at lower levels of

nitrogen the impact of Azospirillum or Azolla was not good.

Effect of stand geometry on growth and vield of transplanted rice

A.S. Panwar, N.P. Singh and U.K. Hazarika

An experiment was designed to find out the best stand geometry to achieve higher yield of low land rice (DR-92) with eight treatments and three replications. The result of one-year study revealed significant differences in grain yield with different population density in both the transplanting arrangements. It was observed that 66 hills/m² was the best for optimum yield in both the planting arrangement. The highest yield being at par with rest of the line transplanting geometry was recorded with line transplanting with two seedlings in 66 hills/m² (36.67 q/ha).

Integrated nutrient management in lowland rice (cv. RCPL-1-3)

U.K. Hazarika, N.P. Singh and D.C. Saxena

An experiment was conducted to assess the yield performance of high yielding rice cv. RCPL 1-3 under different integrated nutrient management (INM) under low land situation of Meghalaya. It was found that crop applied with FYM @ 5 t/ha +60 kg N + 25 kg ZnSO, /ha produced highest grain yield (39.5 q/ha), followed by the treatment applied with 2.5 t FYM/ha+60 kg N +25 kg ZnSO, (36.9 q/ha) and FYM 5 t/ha+ N 30 +ZnSO, 25 kg/ha (36.1 q/ha). Crop without inputs registered 27.7 q of grain yield/ha. Rice crop applied with 2.5 t of FYM without other nutrients produced 29.7 q/ha while increasing the level of FYM to 5 t/ha increased the grain yield to 30.5 q/ha. An additional yield of 8 q/ha was produced due to addition of extra FYM of 2.5 t/ha. The grain yield is further increased to 32.7 q/ha (an additional yield of 2.2 q/ha), when this treatment was enriched with 25 kg of

Crop fertilised with only 30 kg N and 25 kg

ZnSO₄/ha without FYM have also contributed a grain yield of 30.4 q/ha, and equal to that of the treatment applied with 5 t FYM/ha (30.5 q/ha). All the treatments have been found superior in respect of grain and dry matter yield than control.

Integrated pest management in Rice

K. A. Pathak, A. N. Shylesha and K. Rajasekhara Rao Co-ordinated trials (National screening nursery)

National screening nursery (Hills) consisting of 62 advanced yield trial (hills) entries were evaluated for resistance against leaf folder and gundhibug. Six varieties were found to be highly resistant and 21 varieties were found to be moderately resistant to gundhibug infestation. 15 varieties were identified as susceptible and variety VL-93-2767 was found to be highly susceptible to gundhibug. Three varieties were found to be resistant and 14 varieties were found to be susceptible to leaf folders.

Economic pest control trial

Eleven treatments consisting of various concentrations of chlorpyriphos 10G @ 1.0 kg a.i./ha, cartap 4G @ 800 g a.i./ha, fipronil 0.4 G @ 75 g a.i./ha and carbofuran 3G @1.0 kg a.i./ha were tested against leaf folder and gundhibugs. Cartap was found to be highly effective against leaf folders and fipronil was effective in controlling the gundhibug.

Insecticide evaluation trial

Six insecticides were evaluated against leaf folder, gundhibug and WBPH. Monocrotophos 36 SL was found to be effective on WBPH and Monocrotophos and beta cyfluthrin 2.5 SC @ 200 g a.i./ha were effective on leaf folders. No significant results were obtained against gundhibug. Five insecticide mixtures were evaluated against green leafhopper, WBPH, leaf folder and gundhibug. Acephate (5%) cypermethrin (5%) and Upacy 50% DF) combination was found effective against green leafhopper,

WBPH leaf folder and gundhibug. There was no significant difference in other insecticide mixtures.

Optimum pest control trial

Nine varieties were evaluated under optimum pest management practices. Variety JGL-246 and RNR 9891 had lowest WBPH populations and variety BPT-6038 had lowest green leafhopper infestation. Highest yield was obtained in RCPL 1-87-4 (42q/ha) compared to check TN-1 (16.02q/ha).

Indigenous method to trap gundhibug

Gundhibug was found highly attracted to decaying crabs, fish, and other animal proteins. Among them decaying crabs were found to be most effective. Pheromone traps were modified and crabs were placed in place of pheromone and placed during flowering to grain maturity in rice fields. Each trap collected 120-135 gundhibugs per day during peak infestation.

Epidemiology of rice blast and brown spot

M. Srinivas Prasad and M. Santha Lakshmi

A field trial in upland condition with two varieties of rice HR-12 and IRAT 144, by sowing at weekly intervals starting from 5th May had shown that the blast disease appeared in second week of June and the severity was more during July-September. The weather parameters were conducive for higher blast incidence during July to September completed with more rainy days (26-28 days/month). The incidence was less in plots sown in early dates as compared to late sown plots (12th June sown). Crop sown on 5th May had 60% foliar blast, whereas 88% disease was observed in crop sown on 12th June. The blast disease was less in IRAT 144 (15%) from disease appeared during August the occurrence of brown spot was more in middle sown crops. The incidence was maximum (35.55%) in 24th May sown crop.

Integrated disease management of upland rice

Three varieties of rice viz. HR-12, IET 13459 and RCPL 1-29 were evaluated against blast and brown spot in upland condition with four treatments, viz., VT,= variety; VT,= Variety + Bavistin; VT₃ = variety + Fertilizer (60: 60: 40 NPK) and VT_4 = Variety + Bavistin + Fertilizers. In protected treatments, Bavistin (0.05% Carbendazim) was sprayed at 40, 80 and 100 days after sowing. The incidence of blast was only on HR 12. In HR 12, the blast severity was 86.42% in control plots. Spraying of Bavistin reduced the disease (44.94%) considerably. Application of fertilizer increased the blast incidence (80%), however in treatment with both bavistin + fertilizers the disease incidence was less (47.65%). The severity of brown spot was more in IET 13459 (76.29%) than RCPL 1.29 and HR 12. The brown spot incidence was less with the application of normal dose of fertilizers in all the varieties.

Chemical control

Four fungicides, *i.e.*, Beam (0.6g/l), Folicur (1 ml/l), KTU 3616 (1 ml/l) and Hinosan (1 ml/l) were assayed against blast and brown spot under upland conditions on two varieties of rice HR-12 and RCPL 1-29. Among the fungicides, Hinosan reduced the incidence of blast (6.17%), followed by KTU 3616(12.84%). The incidence of blast was also less in plots sprayed with Beam (17.53%) and Folicur (18.76%), whereas in control plot the severity of blast was more (91.6%). All the fungicides reduced the brown spot disease. Reduction of disease was more with Beam (29.87%) in HR-12.

Integrated management of blast disease in lowland rice

Field experiment was conducted with two varieties of rice viz. RCPL 1-87-4 and HR-12. In protected treatments, Carbendazim @ 0.05% was sprayed at 40, 80 and 100 days after transplanting. The incidence of foliar blast was

more in HR-12 than RCPL 1-87-4. In HR-12, spraying of Carbendazim significantly reduced the disease as compared to check (74.3%), but there was no significant difference in the yield.

Fungitoxicity of plant products against rice blast fungus

Anti-fungal activity of water extract of different plant products like turmeric rhizome (Curcuma longa), ginger rhizomes (Gingiber officinalis), garlic bulbs (Allium sativum), pine tree needles (Pinus kesiya) and a commercial neem product (Nimbicidine) were tested. These were bio assayed against Pyricularia grisea, incitant or rice blast at dilutions of 1:2, 1:5, 1:10 in Takahashi's medium and Carbendazim @ 0.05% used as fungicidal check. All these plant products inhibited the mycelial growth completely at 1:2 dilutions, whereas turmeric (1:5), garlic (1:5) and pine (1:10) inhibited the growth. Carbendazim had also reduced the growth completely.

In pot culture studies, pre inoculation spray of turmeric water extract (1:2) exhibited maximum of the blast disease (0.8) in comparison to unsprayed check (6.33). Spraying of grarlic (1:2) before, inoculation reduced the blast disease (1.7) considerably. However, in post inoculation spray with ginger (1:2), garlic (1:2), pine (1:2 and 1:5), the disease severity was 1.87, 1.47, 1.27 and 1.73, respectively. Carbendazim (0.05%) used as chemical check for comparison has been found effective in reducing the blast in both the cases as pre (1.2) and post (1.33) inoculation spray as compared to control (6.33). The observations are on 0-9 scale.

Coordinated rice trials

The varieties received from AICRIP under various trials were screened against the rice blast disease under natural field conditions. Out of 176 entries in NSN-1 trials, 133 lines showed resistant to moderately resistant reaction, whereas in NSN-H, 43 lines were resistant to moderately resistant. HR-12 was the local check with a leaf blast score of 9.

Fungi associated with grain discolouration of rice

Discolouration of rice grains is becoming a major problem in some varieties of rice both in upland and lowland. The discoloured grain of rice cultivars IRAT 246, IRAT 144, IRAT 1512, IRAT 1520, TRC 10, Calaro, DH lines were collected and fungal colonisations were detected with moist blotter method. The cultivars varied in the colonisation of fungi Drechslera oryzae, Fusarium sp., Nigrospora oryzae, Penicillium sp., Sarocladium oryzae and Rhizopus sp. were found associated with the discoloured grains. Among them, the frequency of Drechslera oryzae and Fusarium sp. was more. Out of the cultivars tested, IRAT 246 showed the maximum discoloured grains/panicle, followed by IRAT 144. In a field trials with different levels of nitrogen fertilizers under lowland. More grain discolouration was observed in treatments with high doses of fertilizers (80:80:60 NPK) than normal dose (60:60:40 NPK). The grain discolouration was less in plots sprayed with 0.05% Carbendazim.

MAIZE

Varietal improvement in kharif maize

D.K. Verma and B.K. Sarma

Thirteen trials were conducted to evaluate 348 strains including 221 CIMMYT materials to identify high yielding, disease resistant strains of medium, early and extra-early maturity under rainfed condition. Superior strains identified from different trials are listed in Table 1 and 2.

Development of new strain

In order to increase maize productivity in rainfed agroecosystem of hills, efforts were continued to develop high yielding, short duration, yellow flint hybrids and composites

Table 1. Promising entries of maize identified under different maturity groups at Umiam, Meghalaya

Rank	IET	AET (1)	AET (2)	AET (3)	AET (4)	AET (5)	AET (6)
i gada in	DMR-252 (78.53)	DMR-124 (64.38)	DMR-103 (65.55)	DMR-223 (49.62)	DMR-113 (98.51)	DMR-49 (46.28)	DMR-130 (75.23)
п	DMR-259 (67.99)	DMR-125 (59.94)	DMR-109 (61.05)	DMR-224 (48.89)	DMR-116 (94.78)	DMR-51 (38.42)	DMR-131 (63.27)
m	DMR-260 (63.27)	DMR-126 (55.5)	DMR-110 (55.22)	DMR-230 (48.23)	DMR-117 (86.09)	DMR-56 (39.41)	DMR-133 (62.10)
Trial Mean	59.96	50.61	51.96	43.26	90.52	37.63	51.78
Entries	39	8	13	13	4	4	11
SE ±	0.049	0.069	0.059	0.054	0.126	0.015	0.063
CD	10.09	14.21	12.15	11.12	5.95	- 3.09	12.98

^{*}Figures in parenthesis indicates grain yield (q/ha)

Table 2. Promising entries of maize identified under different maturity groups at Umiam, Meghalaya

Rank	NEH	EVT-17 (CIMMYT-2000)	IPTT (CIMMYT-2000)	RCRT-2000	RCPC-2000	RCBC-2000
T CHARLES	SW DMR-91 -145-1(60.72)	POP903.C.2 (63.34)	P30C8H-75-2XCL- 04935 (54.38)	Vijaya (59.45)	RCM-75 (38.81)	RCBC-4 (32.33)
II	Munneng-8331 (60.38)	BA.98903-N (58.34)	P30C8H-156-1XCL- 04935 (51.88)	NE Comp (61.15)	RCM-76 (35.52)	RCBC-9 (31.92)
m	Seta Lagos- 853(52.06)	ACROSS 98902/ 90352 (56.66)	P30C8H-69-3XCL- 04935 (51.88)	MCU-508 (64.8)	RCM-54 (30.02)	RCBC-5 (29.34)
Trial Mean	48.95	40.95	48.94	52.64	34.34	25.89
Entries *	16	25	196	14	30	10
SE ±	0.091	1.260	1.163	1.802	1.63	1.212
CD	1.88	2.59	2.39	6.68	3.35	2.50

^{*}Figures in parenthesis indicates grain yield (q/ha)

possessing resistance to H. turcicum leaf blight.

Hybridization and evaluation of segregating population: $122 \, F_3$ materials, $27 \, F_4$ materials, $37 \, F_6$, 8 area populations and 6 differential anthocyanin pigmented materials were evaluated for various agronomical traits.

Evaluation and maintenance of germplasm

77 desirable inbred lines of early and medium maturity were evaluated for yield, ear leaf area, better plant type, lodging resistance, tolerance to disease and pests, earliness and lower ear placement, out of which 24 were received from DMR, New Delhi. A total of 146 germplasm were collected from Mizoram and Meghalaya under NATP on Plant Biodiversity and sent to NGB, NBPGR, New Delhi for long term storage.

Nucleus seed production

Nucleus seeds of RCM-75 (1kg), RCM-76 (2kg), RCM 1-1 (10kg), RCM 1-2 (5kg); RCM 1-3 (8kg), OCM-2 (5kg), Coix (1 kg) were produced

by maintaining time and/or distance isolation for further production of breeder seeds.

Breeder seed production

Breeder seeds of RCM 1-1 (95kg), RCM 1-2 (80kg), RCM 1-3 (150kg), RCM 1-4 (10kg), OCM-2 (50kg), Coix (6 kg) were produced by maintaining rime and/or distance isolation for further production of breeder seeds during *kharif* 2001.

Varietal demonstration/crop cafeteria

RCM 1-1, RCM 1-2, RCM 1-3, MLY, MLW, Vijaya, No 91319 and Gujarat Makki-1 were demonstrated for their production potential in farmers' fields, State Govt. Farms and KVKs.

Intergenotypic trial

G. Sahay, D.K. Verma and B.K. Sarma

To breed multiple genotypes for cropping systems was felt the need of the hour. The advanced generation breeding material was screened for suitability in intercropping systems. Three trials *viz.*, Maize+Groundnut, Maize+Urdbean and Maize+Mungbean were conducted. The seeds were sown on 20th June 2000 with the recommended doses of fertilizers and spacing in 3 replications. The details are as below:

Maize+groundnut: This trial comprised of 3 maize entries (RCM 1-1, RCM 1-2 and RCM 1-3) and 3 groundnut entries (JL-24, ICGS-1 and ICGS-76). ICGS 76 yielded 15.0 q/ha with maize varieties.

Maize+urdbean: This trial comprised of 3 maize entries (RCM 1-1, RCM 1-2 and RCM 1-3) and 2 urdbean (UG-218 and PU-19).

Maize+mungbean: This trial comprised of 3 maize entries (RCM 1-1, RCM 1-2 and RCM 1-3) and 2 mungbean entries (PDM-11 and PDM-54).

Genetic differences existed among genotypes for their performance in the intercropping

systems and characters suitable for intercropping were identified.

Front line demonstrations

D.K. Verma, B.K. Sarma and Rajesh Kumar

151 frontline demonstrations (FLDs) were planted in Ri-Bhoi district during *kharif* using Vijaya Composite, RCM 1-1, RCM 1-2 and RCM 1-3 in collaboration with the state department of agriculture, Meghalaya and division of Agril. Extension. The date of planting at various farmers field had ranged from 1st June 2000 to 26th June 2000. The average yield per demonstration observed in Ri-Bhoi was 13.78 q/acre for Vijaya Com., 10.94 q/acre for RCM 1-2, 14.30 q/acre for RCM 1-1 and 15.21 q/acre for RCM 1-3.

Sixteen FLDs were planted in Ri-Bhoi district using varieties Vijaya Comp, RCM 1-2 and RCM 1-1 in collaboration with the State department of agriculture, Meghalaya and Division of Extension after the harvest of first maize crop. The previous maize crop was harvested before the first fortnight of August. The date of planting at various farmers' fields ranged from 14th August 2000 to 14th September. The average yield (green cobs) per demonstration observed in Ri-Bhoi for Vijaya Comp was 6988 cobs/acre and 5907cobs/acre for RCM 1-1.



Green Cobs

Varietal evaluation in pre rabi maize

D.K. Verma and B.K. Sarma

Pre *rabi* maize trial (PRMT) as a new adventure of maize crop after the harvest of first crop was started with the twin objective of increasing the maize production of the region and provide fodder during the fodder lean period. Due to stray grazing, it was impossible to have the crop upto drying stage and hence the crop was harvested at the green ear stage. Two preliminary trials of PRMT were planted with the improved populations of maize. The trials were sown after the harvest of first crop, *i.e.*, after 15th August 2000.

Response of rainfed maize under different methods of sowing to nitrogen

S.K. Gupta

The result showed that increasing levels of nitrogen upto 120 kg/ha increased the maize grain yield significantly, which produced 33.83 q/ha, followed by application of 90 kg N/ha, which yielded 30.29 q/ha. Further, the ridge method of sowing yielded 28.11 q/ha maize grain, followed by plain sowing and boon system of sowing, which yielded 25.42 and 24.30 q/ha, respectively. The interaction of ridge sowing with 120 kg N/ha application produced the highest maize grain yield (41 q/ha), followed by application of 90 kg N/ha which yielded 33.35 q/ha.

Effect of phosphorus, FYM and lime on yield, P uptake by maize and forms of soil acidity in typic hapludalf of Meghalaya

M.S. Venkatesh, B. Majumdar, Kailash Kumar and Patiram

Field experiment on the effect of P levels, FYM and lime on yield, P use efficiency by maize (cv RCM 1-1) and forms of soil acidity was repeated for the second year during *kharif* 2000 at 1CAR Research Complex farm, Umiam,

Meghalaya. Application of 60 kg P₂O₅ with 5t FYM and 2t lime/ha resulted in a significant increase in yield (55 q/ha) test weight and P uptake by maize. P use efficiency was maximum at 60 kg P₂O₅ /ha when applied with FYM and lime. Status of available P and exchangeable Ca and Mg in post harvest soil also increased due to application of phosphorus, FYM and lime but there was a considerable decline in exchangeable Al due to liming. Exchangeable acidity registered a decline up to 72 per cent due to liming, whereas the influence of liming on potential acidity was negligible.

Effect of nitrogen, sulphur and pig manure on maize and residual effect on mustard in acid soils of Meghalaya

B. Majumdar, M.S. Venkatesh, Kailash Kumar and Patiram

Field experiment was conducted for second year during *kharif* and *rabi* seasons of 2000 in factorial RBD with 3 levels of N (0, 50 and 100 kg/ha), 2 levels of S (0 and 20 kg/ha) and 2 levels of pig manure (0 and 5 t/ha) in combinations to evaluate the effect on yield and nutrient uptake by maize and residual mustard. The grain and straw yield of maize and mustard increased significantly with the application of N, S and pig manure. Main and interaction effects were significant for N uptake and residual available N in the soil. The agronomic efficiency (kg yield/kg N) was 22.8 and apparent N recovery (%) was 53 and 49.5 for 50 and 100kg of applied N in case of maize.

Screening of maize for Cob borer

K.A. Pathak

Screening for cob borer under NEH1 (Old) trial 18 varieties were screened and varieties Hin-29 recorded lowest cob borer infestation of (20%) compared to highest in Munneng -8833, RCM1-3 (Check) and Vikram (53.3%). In NEH -2 (Old) ten varieties were screened and variety RCM 1-1(26.67%) had lowest infestation compared to

MLY (40%) and NLD (40%). Under NEH 1 (New) 16 varieties were screened and variety Kiran and Suwan composite were found susceptible with 86.7% infestation compared to Dhawal (60%), Suwan -8529 (60%) and NLD-DEP-106 (60%).

Integrated pest management (IPM) in maize

A. N. Shylesha, K. A. Pathak and K. Rajasekhara Rao

Varietal screening for cob borer

Eight advanced lines including 3 released varieties were evaluated for cob borer Stenachroia elongella infestation. APM-3 (30%) and APM-5 (15%) were found to be susceptible. RCM-1-1, RCM1-3 and Meghalaya local yellow recorded very low infestation (6-12%).

In another trial consisting of five commonly used varieties the damage by cob borer was evaluated. Maximum number of cob borer larvae was found in RCM 1-2 (0.38 per cob), followed by Meghalaya Local White (0.34), RCM 1-3 (0.26), RCM 1-1 (0.16) and the Meghalaya Local Yellow recorded the least number of larvae (0.08 per cob).

Incidence of cob borer on different dates of sowing

Maize cob borer, Stenachroia elongella Walk was found to be the major pest infesting maize. Early sown (first week of April) crop was suffered least by the cob borer. Among the three varieties sown during the first week of April RCM 1-2 recorded higher cob borer damage (20.0%) compared to either RCM 1-1 (3.3%) or local yellow (4.4%). RCM 1-2 was found to be highly susceptible (65.11% cob damage) during all the three different dates of sowing (first week of April, last week of April and last week of May).



Pigeonpea

B.K.Sarma, G. Sahay and Alpana Das

Two varietal trails namely Extra Early

Coordinated Trail (EACT) and trail received from BARC Mumbai, were conducted. In EACT, seven extra early varieties were evaluated for the third year. Varieties AF-345, AF-284 and AF-239 performed well yielding 9.8, 8.2 and 7.5 q/ha, respectively. Ten varieties received from BARC were evaluated for the first year. TT-9801, TT-44-8 and TT-16 were three top ranking varieties and the average yield of the trial was 5.08 q/ha.

Biotechnology

Alpana Das and A. Pattanayak

Efficient plant regeneration system from callus is a pre-requisite for any transformation system. Different concentration of hormones were tried for best callusing in the cultivars of UPAS 120, Tripura Local and AF 239. Among the combinations tried MS along with 2mg/L BAP and 0.5 mg/L 2,4 D proved to be best for obtaining callus from cotyledons. Callusing was upto 90% in this combination. For leaf callus MS along with 2mg/L Thidiazuron proved to be optimal. Callusing was more than 80%. This callus upon transfer to hormone free medium developed shoots. The percentage of regeneration is 2-3%. The calli were co-cultivated with Agrobacterium tumefaciens strains LBA 4404 harboring a plasmid hygromycin phospho transferase (hpt) as selectable marker and Cryl A(c) as the gene of interest for recovering pod-borer resistant plant.

Rice-bean

B.K. Sarma and G. Sahay

Out of 8 varieties tested in Research Complex Regional Trial (RCRT), RCRB 6-10 (9.14 q/ha), EC-2074 (8.47 q/ha) and EC-1667 (7.11 q/ha) were the highest yielders. In the second trial with 38 genotypes, the yield performance was very promising, the trial mean being 8.71 q/ha. The five top yielding varieties were: EC 12562 (17.0 q/ha), RCRB1-3 (13.53 q/ha), IC-19097 (12.14 q/ha), IC-3074 (12.05 q/ha) and IC-176563 (10.80 q/ha).

Mungbean

B.K. Sarma and G. Sahay

In all, 5 trials [Initial Varietal Trial (IVT) and Advanced Varietal Trial (AVT)] were conducted during *kharif* and pre-*rabi*. In *kharif*, out of a total of 29 entries in two trials, varieties 99M-39 (8.11 q/ha), 99M-13 (5.01 q/ha) and 99M-11 (4.76 q/ha) gave maximum yield, the trial mean being 1.89 q/ha. The performance of materials received from BARC, Mumbai was poor. The performance of varieties tested during pre-*rabi* was also not encouraging as evident from the trial mean of only 1.25 q/ha. However, the yield of varieties 2 KM-102 (6.50 q/ha) was quite good in comparison to rest of the varieties.

Urdbean

B.K. Sarma and G. Sahay

44 varieties were evaluated in *kharif* in 3 trials (AVT, IVT and BARC trial) and varieties DPU- 91-7 (3.81 q/ha), 99U-26 (4.98 q/ha), 99U-46 (4.60 q/ha),TAU-2 (6.05 q/ha), TU-96-1 (5.42 q/ha) and TPU-4 (5.35 q/ha) were top yielders in different trials. A total of twenty-eight entries were evaluated in pre-*rabi* season for the first year. The performance of varieties *viz.*, 2KU-187 (10.47 q/ha) and 2KU-205 (10.41 q/ha) was highly promising, followed by 2KU-203 (8.36 q/ha), 2KU-214 (7.99 q/ha) and 2KU-208 (7.59 q/ha). Average yield of the trial was 5.73 q/ha.

Germplasm maintenance and evaluation

B.K. Sarma, G. Sahay and J.K. Singh

Sixty three germplasm comprising mungbean, uradbean, pigeon pea, rice bean, cowpea and french bean were collected from Mizoram and Meghalaya under NATP. The materials were sent for long term conservation in NGB, NBPGR, New Delhi. Seven accessions of rice bean and 38 collections of cowpea collected during 1999-2000 were evaluated. Enormous variability was exhibited by the germplasm in different plant characters studied.

Growth pattern and economic yield in blackgram (Vigna mungo L.)

D. P. Patel and N. P. Singh

Six black gram genotypes viz. TAU-1, TAU-2, TPU-4, TU-97-14, TU-99-40-2 and TU-99-293 were evaluated during pre-rabi season of 2000. Significantly higher root length was observed in TPU-4 (19.5cm), followed by TAU-1 (16.9cm) and TAU-2 (16.6cm). Branch/plant was found maximum in TU-99-40-2 (3.0) and minimum in TAU-2 (1.2). 1000 seed weight was recorded significantly higher in TPU-4 (50.0g), followed by TAU-1 (48.5g), TAU-2 (48.0g) and lowest was observed in TU-97-14 (34.5g). Non-significant differences among the varieties were found for biomass production/plant, plant height, pods/ plant, pod yield/plant, seed/pod, leaf no. /plant, seed yield/plant as well as seed yield. Whereas, the highest mean grain yield was recorded in TAU-2 (10.4 q/ha), followed by TU-99-293 (9.4 q/ha), TAU-1 (9.0 q/ha) and Tu-97-14 (8.8 q/ha).

Effect of date of sowing on blackgram cultivars

D. P. Patel and N. P. Singh

Significantly higher grain yield (q/ha) was produced irrespective of the variety when sowing was done in the first week of August. Further delay in sowing beyond mid August, grain yield decreased drastically. Biomass/plant was found significantly higher in variety PDU-1 (12.7g/plant). Grain yield/plant was recorded significantly higher in PDU-1 (5.4 g/plant).

Spacing

D. P. Patel and N. P. Singh

Number of pods/plant increased significantly with increased plant spacing from 30 x 15 cm to 40 x 15 cm in variety DPU-88-31 whereas, in variety PDU-1 increase was observed upto 30 x 15 cm spacing and thereafter a reduction in pods/plant was observed. Leaf number /plant also showed similar trend as pods/plant in both the

varieties. Biomass/plant, root length, plant height, pods/plant, pod yield/plant, seed/pod, branch/plant, 1000 seed weight, leaf/plant, seed yield/plant as well as grain yield q/ha did not show any significant response in respect of varying spacing.

Integrated nutrient management

D.P. Patel and N.P. Singh

Application of NPK (30:60:40 kg/ha) + FYM (5 t/ha) + *Phosphotica* (1 g/m²) + *Azospirillum* (1 g/m²) produced highest seed yield (10.8 q/ha), which was followed by NPK+ *Azospirillum* (10.6 q/ha) and NPK+FYM (10.4 q/ha) only.

Growth pattern and economic yield in green gram

D.P. Patel and N.P. Singh

Six greengram genotypes were evaluated during pre-*rabi* season of 2000. Seed yield/plant (g) and seed yield q/ha were found highest in TM-97-25 (5.2g, and 8.7 q/ha) and TM-96-2 (5.1g and 7.7 q/ha), respectively. 1000 seed weight was recorded significantly higher in TM-96-2 (37.0g).

Effect of phosphorus, sulphur and molybdenum on yield and nutrient uptake by blackgram

M.S. Venkatesh, B. Majumdar, Kailash Kumar and Patiram

Results obtained from the second year field experiment revealed that combined application of P₂O₅ @ 60 kg/ha, S @ 45 kg/ha and Mo @ 1 kg/ha produced maximum grain yield (12.67 q/ha).

IPM in Pulses

K. A. Pathak, K. Rajasekhara Rao and A. N. Shylesha

Monitoring of insect pests in Pigeonpea

Red gram and rice bean was found to be infested by pod boring *Apion*. Clavipes weevil up to 80%. Blister beetle was found to damage the flowers.

Spatial distribution of pod borer (Apion clavipes Gerst) and red gram pod boring weevil (A. clavipes) was studied using different indices of dispersion. In general, A. clavipes followed positive binomial distribution at higher population and random distribution when the pest population was low.

Chemical control of A. clavipes

Different insecticides were used to control the *A. clavipes*. Among all the insecticides sprayed two times - one at initiation of flowering and another at one month after first spray. Decamethrin @ 0.005 % recorded the lowest pod damage (22.33%), followed by Carbosulfan 25 DS @ 0.025% (37.66%) and Monocrotophos 36 SL @ 0.075% (43.66%).

Decamethrin recorded the lowest seed damage (8.6%) followed by Carbosulfan (17.68) and monocrotophos (19.37%). The highest seed damage was in control (38.65%).

Spatial distribution of pea aphid and its coccinellid predator

The spatial distribution of pea green aphid Acyrthosiphon pisum (Harris) and its coccinellid predator Coccinella transversalis Fab. adults during rabi season. A. pisum followed negative binomial (contagious) and its predator C. transversalis followed positive binomial (regular) distribution with Iwaos patchiness regression equations.

The spatial distribution of stem fly *Melana-gromyza phaseoli* Tryor (Diptera: Agromyzidae) infestation has shown negative binomial distribution. The pupae of *M. phaseoli* in each infested plant followed negative binomial at moderate infestation and Poisson distribution when the infestation was higher.

Biological control of pea aphid

The infection of pea aphid by fungi *Erinium neoaphidis* increased with the increase in the sun shine hours of the winter season and dry cool weather. Parasitization of *A. pisum* by hymenopteran wasps was found to a greater

extent (50-60%). The parasitization started from last week of November and their activity was static till the end of the crop period. Aphids swell and their bodies bulges and the parasites emerge through a circular hole made by them.

Pulse diseases

M.S. Prasad and Y.P. Sharma

Thirty nine varieties/ lines of urd bean were evaluated against powdery mildew. Alternaria blight and BLCV 99 U-43, 41, 48 and 24 were resistant against powdery mildew. BSU-1 was resistant against Alternaria blight but highly susceptible to powdery mildew and BLCV. VBG 23, RUD 59, 99 U-47 and 45 were moderately resistant to Alternaria blight.

OIL SEEDS

Evaluation of offtypes in groundnut

B.K. Sarma and G. Sahay

Repeat assessment of 8 off types selected from JL-24 was made. It was observed that the off-types- JL24/98-8 (26.56 q/ha), JL-24/98-1 (23.99 q/h) and JL-24/98-11 (22.15 q/ha) were top ranking. Average yield of the off types was 22.03 q/ha.

Screening of groundnut for acid upland

100 lines were evaluated for screening in acid upland. Entries ICG-6663 (13.67 q/ha), ICG-6697 (11.77 q/ha), ICG-3327 (9.85 q/ha), ICG-4667 (6.06 q/ha) and ICG-2196 (8.87 q/ha) gave maximum pod yield as compared to rest of the entries. The lines showed an average yield of 5.38 q/ha.

Breeding for disease resistance

Thirty-two materials having rust and frogeye leaf spot disease resistance were evaluated. Lines H 11 (24.83 q/ha), H12 (23.61 q/ha), H13 (21.78 q/ha) and H32 (13.54 q/ ha) were found promising, the average yield of the lines was 16.06 q/ha.

Varietal evaluation in soybean

B.K. Sarma and G. Sahay

In the advanced varietal trial (AVT), out of 41 varieties evaluated for the third year JS (SH) 89-48 (22.88 q/ha) yielded highest pod, followed by NRC-18 (21.66 q/ha), MACS 428 (21.39 q/ha), NRC-25 (20.61 q/ha) and JS (SH) 89-49 (20.00 q/ha).

Date of planting

Thirty-six varieties under IVT were evaluated for two different dates of sowing. Sowing in last week of June yielded more (16.20 q/ha) as against 10.00 q/ha in 3rd week of May sowing. The varieties C-19, C-24, C-21, C-28 and C-7 gave more yield in June sowing whereas varieties C-36, C-19, C-14, C-33, and C-25 produced more pods.

Vegetable soybean

Ten vegetable (green) soybean received from Asian Vegetable Research and Development Center (AVRDC) were evaluated for the first year. Varieties EC-417112 (25.20 q/ha) and EC-417113 (24.10 q/ha) were found promising. The average yield of the trial was 10.95 q/ha.

Germplasm collection and maintenance

B.K. Sarma, G. Sahay and J.K. Singh

In all, 76 germplasm of oilseeds (42 collections of rapeseed-mustard, 1 sunflower, 10 sesamum, 9 perilla, 6 groundnut and 8 soybean) were collected under NATP-PBD from Mizoram, Meghalaya and Assam and sent to NGB, NBPGR New Delhi for long-term conservation. Samples were also sent to Directorate of Oilseeds Research, Hyderabad. Sixty-eight groundnut germplasm lines (44 bunch type and 23 spreading type) were maintained and evaluated. The lines GG-2 (17.0 q/ha), ICGV-86635 (16.6 q/ha), ICGV 88348 (14.72 q/ha), ICGS-76 (14.26 q/ha) and NRCG 655 (14.24 q/ha) gave highest yield. On an average the lines yielded 9.44 q/ha pods.

Effect of soil amendments on pod yield of groundnut

N.P. Singh and D.P. Patel

Application of NPK (20:60:40 kg/ha) + lime (2 t/ha) produced highest biomass/plant (23.2 q), pods/plant (11.1) and pod yield/plant (12.5 g), followed by FYM (10 t/ha) application alone. Application of FYM (10 t/ha) + NPK (20:60:40 kg/ha) + Lime (2 t/ha) produced highest pod yield (22.9 q/ha), followed by FYM @ 10 t/ha (21.6 q/ha) and NPK @ 20:60:40 kg/ha (21.2 q/ha) alone.

Varietal performance on groundnut

N.P. Singh and D.P. Patel

Eleven varieties were evaluated for yield and yield attributes. Highest dry matter accumulation per plant (g) was observed in TKG-19A (44.7 g) followed by ICGS-44 (23.2 g) and TG-26 (22.2 g). Pod yield was recorded highest in K-134 (18.4 q/ha) followed by R-9251 (16.3 q/ha) and TKG-19A (13.7 q/ha).

Effect of Rhizobium and PSM on growth and yield of groundnut

A.S. Panwar, N.P. Singh and D.P. Patel

An experiment with two levels of phosphorus (0 and 60 kg P,O,/ha) in main plot and eight treatments viz., B1-Control, B2-Rhizobium, B3phosphorus solubilising microbes (PSM), B4-B2 + B3, B5-neem cake @ 30 q/ha, B6- FYM @ 100 g/ha, B7 Neem cake @ 15 g/ha + B4 and B8-FYM @ 50 q/ha + B4 in sub plots revealed that application of phosphorus @ 60 kg P.O./ha significantly increased the yield and yield attributing characters. Among the bio- organic treatments, highest yield (29.97 q/ha) was recorded with neem cake @ 15 g/ha + Rhizobium+PSM, which was 8.2 and 9.3 per cent higher over the yield recorded with application of FYM @ 100 q/ha and Neem cake applied @ 30 g/ha, followed by the yield recorded due to FYM application @ 50 g/ha + Rhizobium and PSM (29.40 q/ha).

Performance of groundnut cultivars

S.K. Gupta

The result showed that variety TG-26 yielded the highest pod yield (26.25 q/ha), followed by TAG-24 and TG, which produced 23.07 and 18.96 q/ha yield, respectively. Plain and ridge method of sowing differ significantly and ridge method produced numerically higher pod yield than that of plain sowing. Variety TG-26 with ridge method of sowing produced the highest yield (29.03 q/ha).

Inter-genotypic trial

Three groundnut varieties were tested with 3 maize varieties for the second year to know the extent of inter genotypic competition amongst themselves. Variety ICGS-76 (15.75 q/ha) showed highest yield with maize variety RCM 1-1.

Effect of rock phosphate, phosphate solubalising microbes and gypsum on yield and nutrient uptake by groundnut

M.S. Venkatesh, B. Majumdar, Kailash Kumar and V.K. Mishra

A field experiment was conducted during the *kharif* season of 2000 to study the effect of rock phosphate, phosphate solubulising microbes and gypsum on yield and nutrient uptake by groundnut (ICGS 76). Application of RP @ 50 kg P2O5/ha resulted in significant increase in pod yield (27.58 q/ha), Shelling percentage (79.5), P and S uptake (7.3 and 5.4 kg/ha, respectively) by kernels. Seed inoculation with PSM and application of gypsum @ 30 kg S /ha significantly increased the yield and nutrient uptake by kernels. The interaction effect between P, PSM and gypsum was significant.

Effect of sulphur and boron application with and without FYM on groundnut in acid soil

B. Majumdar, M.S. Venkatesh, Kailash Kumar and Patiram

A field experiment was conducted on an acid

soil during *kharif* 2000 with 3 levels of S (0, 20 and 40 kg S /ha), 3 levels of B (0,1.5 and 3 kg B/ha), 2 levels of FYM (0 and 5 t/ha) to find out their effect on the yield, nutrient composition and quality of groundnut. The pod yield of groundnut increased significantly with sulphur, boron and FYM application. The interaction between S and B and FYM was synergistic for pod yield.

Efficiency of phosphatic fertilizers to soybean in acid Alfisol of Meghalaya

B. Majumdar, M.S. Venkatesh, Kailash Kumar, Patiram and V.K. Mishra

Field experiment was conducted for second year during *kharif* 2000 to study the effectiveness of different levels of SSP (super-phosphate) and RP (rock phosphate) and their mixtures along with FYM on soybean. SSP @ 60 kg P_2O_5 /ha alone or in combination with 5t ha⁻¹ FYM was superior to rock phosphate @ 30 or 60 kg P_2O_5 /ha alone or with FYM, but was at par with 60 kg P_2O_5 /ha as SSP+RP (1:1) alone or in combination with FYM with regard to grain and straw yield and P uptake. Maximum phosphorus use efficiency of 17.2 per cent was with SSP @ 30 kg P_2O_5 /ha + FYM. Per cent yield response was maximum (80%) with 60 kg P_2O_5 /ha as SSP +FYM.

IPM in Oil Seeds

K. A. Pathak, K. Rajasekhara Rao and A. N. Shylesha

Varietal screening in groundnut

Groundnut varieties were screened for insect pest incidence. Jassids, blister beetle, and leaf folders were found to be the major pests attacking the foliage and pod borer (false wire worms) on pods. 17 varieties were found resistant and five varieties were found to be susceptible to pod borer incidence. The remaining recorded 5-10% infestation.

Chemical control

Application of carbofuran 3G @ 1kg a.i./ha

at sowing gave good control against pod borer and foliage pests.

Monitoring of Insect pests in soybean

Leaf folder, shoot fly and stem fly were found to be the major insect pests on soybean. Shoot fly incidence was very high (65%) and severe mortality of seedlings was observed at 30-45 DAS. The hadda beetle (*Henoesepilachna* spp) was found to feed on the foliage up to 50-60% plants during the peak vegetative growth period. Flowers were found damaged by blister beetles.

Distribution of insect pests and their natural enemies in Mustard

Mustard saw fly Athalia lugens proxima was the main insect pest to infest first on the mustard crop in winter followed by cabbage butterfly Pieries brassicae. Their attack started from 15 days after sowing and increased with the age of the crop till the seed setting. The lowest number of saw fly grubs were recorded during the second week of sowing was 84 grubs/sq.m. followed by 107/sq.m (during 3rd week) and 113/sq.m. (during 4th week). The mustard aphid infestation started from the flowering season and simultaneously the predatory coccinellid beetle emergence started with the aphid and saw fly infestation. A number of coccinellid beetles (Coccinella septumpunctata, C. transversalis, Brumus suturalis) were found predating on these insect pests. The bright sunshine hours coupled with the cool dry weather favoured the build up of these coccinellid predators. The highest number of beetles found were 50/sq. m. during the flowering season and during the harvest their activity was very high (200 beetles/sq.m.) and indicated their use in biological control.

Varietial trial

Different varieties of mustard were screened for aphid resistance. None was found resistant and the highest numbers of aphids were found on Gobi sarson (171.7/plant) followed by Toria (138.6). The least number of aphids were found on Varuna (83.4) and Yellow sarson (92.3/plant).

Screening against early leaf spot (Cercospora arachidicola Hori) of groundnut

Satish Chandra

Out of 100 genotypes screened under natural epiphytotic condition at Umiam during rainy season only 16 entries showed moderate level of resistance (Score 4.5-5.0) on a 1-9 scale (where 1= no disease, 9= 50-100% foliage destroyed) and rest of the genotypes exhibited moderately susceptible (Score 6.0) to highly susceptible (score 7.0-8.5) reaction against early leaf spot diseases. The genotypes that exhibited moderate level of resistance were ICG 378 5, 6663, 3073, 10506, 3133, 7610, 3383, 10384, 4647, 5185, 3695, 3282, 3497, 6497 and 3369.

Rust (C.o. Phakopsora pachyrhizi) and frog eye leaf spot (Cercospora sojina) against soybean

M. Santha Lakshmi Prasad, M. Srinivas Prasad and Satish Chandra

75 soybean cultivars were evaluated against rust and frog eye leaf spot under natural disease pressure at Barapani. Ankur was used as susceptible check. Four cultivars, *i.e.*, NRC 12, 24, 28, 31 were early maturing ones so they escaped the rust incidence and had shown highly resistance reaction to frog eye leaf spot. NRC 2, MACS 24, PK 327, DS 93-108 B cultivars exhibited resistant reaction to both diseases. DS 93-108 B was the highest yielder (14.1 g/plant) with resistance to both the diseases.

Chemical control of rust and frog eye leaf spot of soybean

M. Santha Lakshmi Prasad, M. Srinivas Prasad and Satish Chandra

The efficacy of fungicides on frog eye leaf spot and rust was evaluated at Barapani with susceptible variety Ankur in a replicated trial. Eight fungicides and a plant product-nimbicidin were sprayed after the appearance of disease on leaves. Another spray was given one week after first spraying. The diseases were scored on 0-9 scale. All the chemicals significantly reduced the incidence of frog eye leaf spot. Benlate, Kavach, Dithane M-45, Folicur and Tilt were equally effective in controlling the frog eye leaf spot. However, the fungicides did not show any significant reduction in rust incidence.

Bio control of soybean rust

M. Santha Lakshmi Prasad, M. Srinivas Prasad and Satish Chandra

The efficacy of Trichothecium roseum, a mycoparasite on rust fungus Phakopsora pachyrhizi was studied in pot culture. Thirty day old soybean plants (Bragg) were sprayed with spore suspension of T. roseum (1.5 x 108 conidia/ml) 24 hours before rust uredospore inoculation (Pre inoculation) and 24 hours after rust uredospore inoculation (Post inoculation). One additional spray of T. roseum was given 5 days after inocultion. Plants sprayed with dithane M-45 @ 0.25% 24 h after uredospore inoculation served as fungicidal check and another set of plants, which were inoculated only with uredospore suspension as check. The data on number of rust lesion and sporulating lesions/ trifoliate was recorded. Pre and post inoculation spray of T. roseum on soybean plants reduced number of rust lesions and percent sporulating pustules/ trifoliate as compared to unsprayed check. However, it is not at par with the fungicide check. In plants treated with T. roseum and dithane M-45, no rust lesions were observed on upper trifoliate leaves as compared to check. The disease control with T. roseum and dithane M-45 applications was 74% and 89%, respectively.

CROPPING SYSTEM RESEARCH

Nutrient management in maize groundnut intercropping systems

U.K. Hazarika and N.P. Singh

An experiment with 3 cropping system, viz; maize (sole), maize+groundnut (1:1) and

maize+groundnut (1:2) with 5 nutrient levels, i.e, F-0 (control), F-1 = recommended dose of NPK (100:80:50kg/ha); F-2= 75% of recommended dose of NPK (75:60:30 kg/ha), F-3= 50% of recommended dose of NPK (50:40:25 kg/ha); F-4=25% of recommended dose (25:20:12.5 kg/ha); F-5=10 tones of FYM/ ha, were taken in a R.B.D with three replication during kharif, 2000. Maize equivalent yield (MEY) was calculated @ Rs. 400/q for maize and @ Rs. 1000/q for groundnut. Data revealed, that maize sole crop produced a grain yield of 33.0q/ha, irrespective of fertilizer levels, while maize + groundnut (1:1) row ratio recorded 43.6 q/ha of MEY and maize + groundnut (1:2) row ratio produced highest MEY of 45.23 q/ha. F-1 registered highest MEY of 46.15 q/ha among the treatments, which was followed by the 10 ton FYM/ha (43.2 q/ha) of MEY. Under F-1 lowest MEY (33.3 q/ha) was recorded.

MILLETS

Trapping cob borer using sorghum as trap

A. N. Shylesha, K. A. Pathak and K. Rajasekhara Rao

Five varieties of *rabi* sorghum were evaluated for use as trap crop during the *kharif* season. Cob borer infestation was more on varieties 15-2312 and Maldani (50-60%) and thus can be used as trap crop. The other varieties had less than 40% infestation.

Weed survey in east Khasi and Ri-Bhoi district of Meghalaya

Rajesh Kumar, N.P. Singh and U.K. Hazarika

Survey of weed species was undertaken under upland and non-cropped areas in the research farm and farmers field of Umiam and Pyllun villages during rainy season. Under non-cropped/ abandoned land, Galinsoga parviflora was recorded as most dominant weed followed by Bidens pilosa and Ageratum conyzoide, among dicot weeds. In monocot weeds, Digitaria

sp. was recorded as most competitive one, whereas Panicum repens and Eleusine indica spotted second and third dominant weeds. Under upland rice condition, Cyperus iria was recorded as most dominant weed. Digitaria sp. and Rotala rotundifolia followed it. Ginger crop had the most dominant weeds from compositae family. Ageratum conyzoides was the most ubiquitous weed.

BIO-FERTILIZER

Effect of phosphorus sources and water levels of ponds on the green biomass production of Azolla

U. K. Hazarika, A.S. Panwar and D.C. Saxena

To assess the total annual productivity of Azolla caroliniana, due to phosphorus and water level in low land in the month of May to late December an experiment was initiated. The phosphorus was supplemented through SSP and dry FYM @ 20 kg P,O,/ha/harvest. The experiment was carried out in newly digged ponds with 10 treatments under three replications. The treatments were: T-1 (Water level 1 cm + SSP), T-2 (water + SSP), T-3 (water level 10 cm + SSP), T-4 (water level 15 cm +SSP), T-5 (water level 20 cm + SSP), T-6 (water level 1cm+ FYM), T-7 (water level 5 cm + FYM), T-8 (water level 10 cm + FYM), T-9 (water level 15 cm +FYM), T-10 (water level 20 cm + FYM). It was revealed that p as well as water level has direct effect on green biomass production of Azolla. The water level of 10-15 cm in the pond was found optimum for the growth and biomass yield of Azolla. Higher water level beyond 15 cm has adverse effect. During the year Azolla yield was higher in the month of August and September and there after yield was decreasing owing to the low temperature.

Phosphorus sources for Azolla

U.K. Hazarika, A.S. Panwar and D.C. Saxena

SSP was found as the superior source of

phosphorus than FYM. Phosphorus supplied @ 20 kg/ha as SSP was proved beneficial for the growth, vigour and multiplication of *Azolla* under low land agro-ecology of Meghalaya. Phosphorus @ 20 kg as SSP has produced 70.7 q/ha of biomass annually while P supplied through FYM registered 61.7 q/ha of biomass yield /year irrespective of water levels of ponds. Among the treatments 15 cm water + 20 kg P as SSP was found superior to all the treatments (134.6 q/ha), followed by 126.8 q/ha due to 10 cm water depth with P applied as SSP.

MUSHROOM

Evaluation of *Pleurotus* species for growing on bamboo dust

Satish Chandra, A.K. Singh and Y.P. Sharma

Bamboo dust, a waste from paper mills was tested for growing oyster mushrooms (*Pleurotus* spp) by polybag method. Paddy straw served as standard check for yield comparison. Of three species and two strains tested, *P. citrinopileatus* gave the highest yield (808g fresh wt./kg of dry substrate), followed by *P. sapidus* (528g), *P.*

sajorcaju (460g), P. flabellatus R (460g) and P. flabellatus S (373g) on bamboo dust. However, yields were higher on paddy straw and ranged 830-1100g. The results indicated that P. citrinopileatus could be successfully grown on bamboo dust with 81% biological efficiency (BE), which was only 3% lower than paddy straw. The slight reduction in BE may be compensated for the cost of cutting the straw. It is concluded that the bamboo dust, a waste, can be successfully utilized for Oyster mushroom cultivation. Effect of substrate on fruit body characteristics was also studied. P. citronopileatus and P. flabellatus (R) showed significantly higher fruit body weight, fruit body length and pileus diameter on bamboo dust compared to paddy straw.

FRUITS

Rootstock study in Citrus

A.K. Dubey

An experiment with *Khasi* mandarin budded on different rootstocks (Trifoliate orange, Tayum, Rough lemon and Volkamariana) showed that *Khasi* mandarin budded on Tayum had highest



Mushroom Training at Village level

plant height (40.50 cm), scion length (27.70 cm) and scion diameter (2.05 cm). whereas, rootstock diameter was recorded maximum (3.55 cm) in Volkamariana. The Volkamariana and Rough lemon had highest number of branches (3.00).

Studies on soft wood grafting in Khasi mandarin

A.K. Dubey, M. Mishra and D.S. Yadav

In softwood grafting of *Khasi* mandarin, maximum plant height (32.14 cm), length of scion (21.60 cm), diameter of scion (13.82 mm), number of leaves (15.20 leaves/plant) and spread (16x11 cm²) were found in Pumelo used as rootstock.

Studies on maturity indices of mandarin oranges

In *Khasi* mandarin, TSS content of 10.24-10.30% were observed highest from 24th November to 24th December and acidity was recorded lowest on 9th December. In Kinnow fruit, the maximum TSS was recorded on 9th December. The highest TSS: acid ratio (12.13-13.67) was recorded from 9th December to 24th December. In Sikkim orange, maximum fruit weight (130.40 gm), fruit diameter (6.670mm), juice content (65.10 ml) and TSS: acid ratio (12.99) were recorded on 24 December, whereas, maximum volume (185.70 ml), length (63.50 mm) and TSS (11.40%) were found on 9th December.

Isozyme studies in Citrus

Maneesh Mishra

Isozyme analysis conducted for two enzyme viz., Glutamate Oxaloacetate Transminase (GOT) and Esterase (EST) utilizing leaf samples collected from micropropagation, micrografting and Nucellar mother plants of Khasi mandarin using polyacrylamide gel electrophoresis showed similar banding pattern in all the samples tested, which confirm that all the plants were genetically pure.

Screening of guava hybrids

K. Dhinesh Babu and D.S. Yadav

Seven guava (Psidium guajava) varieties of about 6 year old plants were evaluated for their yield performance and quality trajts. The maximum yield per tree was obtained from Lucknow-49 (17.92 kg), followed by Allahabad Safeda (17.55 kg) and Selection 1(15.97 kg). The study concludes that besides Lucknow-49 and Allahabad Safeda, the guava cultivars Selection-11 and Selection-7 with better quality and yield traits, respectively, can also be adopted for commercial cultivation in lower mid hills.

Determination of maturity standards for peach variety TA-170

K. Dhinesh Babu and D.S. Yadav

An experiment was laid out to determine the maturity standards in six year old trees of peach variety TA-170. The best results were obtained on 76 days after fruit set for fruit weight 933.33g), fruit length (34.33mm), fruit diameter 34.20mm), fruit volume (38.33ml), TSS (11.90%), titrable acidity (0.70%), TSS/acid ratio (16.96), ascorbic acid (230.67 mg/100g) and total sugars (5.50%). Samples collected on or later to 83 days after fruit set failed to bring significant improvement for the maturity standards and showed a negative trend. Hence, it is advisable to harvest the fruits of peach variety TA-170 during 76-80 days after fruit set.

Physical thinning in peach variety Shan-e-Punjab

The shoots of 90-100 cm length were selected to find out of the optimum-thinning interval between the fruits. The excess fruits in the shoots were removed keeping a thinning interval of 5,10,15,20 and 25 cm between the fruits. A thinning interval of 15 cm is found optimum for obtaining better quality fruits.

Chemical thinning in peach variety TA-170

Different concentrations of 2, 4-D (50,100 ppm), GA (100, 200 ppm), thiourea (2%, 3%), and carbaryl (0.06%, 0.10%) were sprayed at full bloom stage on peach variety TA-170 to study the effect of chemical thinning. The ascorbic acid and total sugars were found significantly high over the control in 2, 4-D, GA and carbaryl treatments.

Determination of leaves to fruit ratio in peach variety TA-170

On the basis of results an LFR of 30:1 is found optimum for producing better fruits of marketable quality in peach variety TA-170 under mid hill conditions of Meghalaya.

Manuring in peach variety Flordasun

The nutritional requirement of six year old peach variety Flordasun with five doses of NPK fertilizers was evaluated. It was found that application of 563:500:250g NPK/tree resulted in significantly higher yield (29.48 kg), fruit weight (47.25g), TSS (12.12%), ascorbic acid (256.00mg/100g) and total sugars (6.38%) over the control. A heavy dose fertilizer beyond this limit could not bring about significant increase in yield and quality of peach fruits.

Pre-harvest spray to enhance the shelf life of peach

K. Dhinesh Babu, D.S. Yadav and Amit Nath

Gibberellic acid (25, 50 ppm) and calcium chloride (0.5, 1.0%) were sprayed to enhance the shelf life of peach variety Shan-e-Punjab. The shelf life of fruits stored under normal condition varied from 10 to 18 days. The untreated control registered the minimum shelf life of 10 days.

Effect of post harvest treatments on quality and shelf life of peach

A study was conducted with waxol 5%,

carbendazim 50%wp 300 ppm, perforated polythene bag individually and in combinations to find out their effect on physiological loss in weight (post harvest weight), shelf life and quality parameters. The best results for PLW, shelf and quality parameters were obtained with waxol 15% + carbendazim 50% WP 300 ppm + perforated polythene bag.

Evaluation of drip irrigation for peach and plum

A.K. Mishra, R.K. Singh, K.K. Satapathy and K.N. Agarwal

There is scarcity of water during lean season spread over November to May. Drip irrigation system was evaluated by planting for the peach and plum crop. In order to evaluate the irrigation requirement for the selected crop, crop water requirement of these crop was estimated using CROPWAT software with the help of agroclimatic data Umiam and crop data. The total crop water requirement for peach and plum crops was found to be 208.2 and 148.6mm, respectively.

Fruit harvester for mountain orchards

S.V. Ghadge

Harvesting of oranges is one of the great problems in mountain orchards as these are mostly found on slopes, which make cultural practices a bit more arduous than those in plains. Harvesting of fruits is normally done by hand picking by climbing the tree directly or with the help of ladder. Use of steel wire and mild steel pipes instead of bamboo strips modified with local bamboo-cone device is more durable than the bamboo cone device. Its projected MS spikes help on easy detachment of fruits through better gripping. This method of harvesting help in saving the fruits from damage as compared to that of shaking /hitting with a stick.

Papaya varietal trails

K. Dhinesh Babu and D.S. Yadav

Fourteen varieties of papaya were evaluated using different concentrations of GA_3 (0, 50, 100, 150 & 200 ppm). Characters like days taken for germination, vigour index, seedling length were studied. The best results were obtained with 150 ppm of GA_3 .

Evaluation of peach fruits suitable for dehydrated slices and quality

A. Nath, N. Rai and D.S. Yaday

Initial physico chemical parameters viz. acidity, TSS, pulp yied and other dehydration parameters such as dehydration ration dehydration yield, rehydration rate rehydration capacity and organoleptic analysis with respect to different storage periods were carried out. It was noticed that TA-170 variety of peach may be considered for dehydrated peach fruit slices.

Improvement in shelf life of peach

A. Nath, N. Rai and D.S. Yadav

An experiment was conducted to see the shelf life of peach by using packaging materials like low density polyethylene ((LDPE), corrugated fibre board (CFB), LDPE + KMnO4 & CFB + KMnO4 and two storage conditions *viz.*, room temperature and refrigeration during May, 2000. The shelf life of the fruits was extended up to 21 days when kept in LDPE + KMnO4 and stored in refrigerator at 4°C. Thus, LDPE + KMnO4 and stored at 4°C may be used for extending the shelf life of peach fruits.

Gin-kinnow-a blended beverages from kinnow madarin juice

A. Nath and R.K. Yadav

Kinnow mandarin juice and ginger juice were blended in the ratio of 0:30, 5:25, 10:20, 15:15, 20:10, 25:5, 30:0, respectively and squash were prepared from these blends. Total soluble solids (TSS) were fixed at 40 to 40.5 °B. Amongst, the blended squash, ratio 25:5 scored the highest in terms of sensory attributes.

IPM in Fruits

K. A. Pathak, A. N. Shylesha and K. Rajasekhara Rao

Spatial distribution of leafminer and aphid in Khasi mandarin

The spatial and temporal changes of the leafminer, *Phyllocnistis citrella* infestation on citrus was studied on different flushes of *Khasi* mandarin (*Citrus reticulata* Blanco). The *P. citrella* infestation followed negative binomial (contagious) distribution with low to medium damage during the first two flushes and Poisson distribution at higher infestation levels during the third flush. Correlation coefficients were calculated and significant differences in infestation patterns with weather were observed in the three flushes. Different multiple linear regression equations were found fit to explain the leafminer *P. citrella* infestation in different flushes of citrus.

The spatial distribution of black aphid *Toxoptera aurantii* Fon. was found to follow the negative binomial series with contagious distribution with an exponent 'k' ranging between 2 to 5. The other indices of dispersion viz., variance mean ratio (VMR), David & Moore Index, mean crowding, patchiness index, coefficient of variation were confirmed the contagious distribution of *T. aurantii*.

Monitoring of insect pests

Citrus trunk borer was the major insect pest on *Khasi* mandarin. Incidence of black fly was noticed on 70% of the plantation. Incidence of mealy bugs, scales and aphids was also found. Leaf feeding caterpillars (unidentified) were found as a major problem in the nursery (poly house). The coccinellid predator *Rodalia fumida* Mulsant was found actively feeding on giant mealybugs. It is a reddish small beetle with golden yellow hairs on the elytra.

Biology of leaf mining beetle, Sebaethe fulvipennis (Alticinae: Chrysomellidae: Coleoptera) in Assam lemon

A chrysomellid leaf-mining beetle *S. fulvipennis* (Illiger) grubs was found feeding on the foliage of Assam lemon (*Citrus limon* Burm) during new flush period. The brick red coloured beetles measured 2.5mm length and 2mm wide feed on young leaves. Each female beetle laid 150-200 eggs in groups covered by abdominal secretions on young leaves, which hatch in 8-10 days. The emerging grubs enter between two epidermal layer and feed on the leaf forming a blotch. 25-40 grubs were found within a single leaf causing complete damage to leaf. After completing feeding they migrate to other leaves and continue the damage. They pupate in soil and emerge during the next new flush period.

Spatial distribution of S. fulvipennis

Studies conducted on the spatial distribution of grubs of leafminer, *S. fulvipennis* indicated that the pest followed negative binomial distribution within the leaf. During the initial and later phases of incidence *S. fulvipennis* followed positive binomial distribution due to low pest density.

For reclamation of declined *Khasi* mandarin orchard the recommended practices involved cutting and burning of completely dead trees, pruning the dead wood, cleaning the basins and application of manure and fertilizers, treating the wounds with Bordeaux paste and the borer holes with DDVP, spraying the plants with tetracycline @7g/ac along with 2% urea and Micronutrients once during first flush and the second during August, drenching of the basin against termite attack using chlorpyriphos 0.05% solution @3lt/basin and destruction of the eggs laid on the trunk.

Citrus

A.K. Singh, M.S. Prasad and Y.P. Sharma

Out of the seventeen citrus species scored for the various disease during the season, the intensity of *Alternaria* leaf spot was more particularly on rough lemon. Other diseases like powdery mildew and greasy spot were also recorded with moderate intensity.

Post harvest loss of the Khasi mandarin

Cushioning of the fruits with paddy straw during storage resulted in least spoilage of the fruits. Out of the three concentrations carbendazim used, 1500 ppm checked the spoilage of the fruits up to four weeks.

VEGETABLES

Improvement

D.S. Yadav, N. Rai and R.K. Yadav

Collection, evaluation and improvement of solanaceous crops

45 germplasms of tomato, 31 germlasms of brinjal and 15 germplasms of chilli have been collected from different parts of the country. Evaluation of germplasm under Meghalaya conditions is in progress.

Breeding for disease resistance in tomato

Four promising selections showing tolerance to late blight and wilt disease were selected/identified from the progeny of F₂ population. Seeds were collected for further generation advancement and selection.

Generation advancement and evaluation

Individual plant selection from the progenies of, F_3 , F_4 , F_5 and F_6 generations were made. Seeds of promising selections were collected for further generation advancement and evaluation.

Collection, evaluation and improvement of beans

Seventy germplasms of French bean and 100

germplasms of *Dolochos* bean have been collected from different parts of the country and are being evaluated under Meghalaya conditions.

An experiment was conducted by using different concentrations of GA₃ (100 and 200 mg/1) NAA (50 & 100 mg/10 and Paclobutrazol (50, 100, 150, 200 and 250 mg/1) along with control on French bean variety Meghalaya Local. Out of ten treatments, Paclobutrazol at 150 mg/1 was found the best treatment for increasing the yield of French bean variety Meghalaya local by suppressing the vegetative growth and enhancing the flowering and fruiting.

Effect of date of sowing on French bean

D.P. Patel and N.P. Singh

The mean green pod yield was recorded higher in Naga local (73.5 q/ha), followed by Meghalaya local (68.8 q/ha). Yield differences at different dates of sowing were found significant. Although, seed yield was found higher in early sown crops but seed quality was poor when sowing was done in the first week of August or prior to this due to heavy rain at maturity of pod.

Rust of French bean and its management A.K. Singh

Rust (Uromyces appendiculatus) and angular leaf spot (Phaeoisariopsis griseola) very are serious diseases of post kharif French bean causing considerable yield loss and limiting its cultivation. Anthracnose (Colletotrichum lindemuthianum) is also affecting the pod causing loss in market value, though in this reporting year its incidence was very low and, therefore not taken into account. Moreover, the crop was abandoned after first harvest due to severe frost injury.

Triadimofon, Carbendazim and Hexaconazole were taken in the experiment either alone or in combination with mancozeb. A neem formulation PJM-C, a margo product was also included in the experiment. Hexaconazole alone and in combination with mancozeb was the most effective in reducing rust severity, followed by PJM-C. Angular leaf spot was managed maximum by Hexaconazole alone or in combination with mancozeb and mancozeb alone, followed by PJM-C. The maximum increase in yield over control was achieved by Hexaconazole alone, followed by PJM-C and Hexaconazole + mancozeb.

It is thus concluded that though Hexaconazole was most effective in reducing rust and angular leaf spot severity and yield increase, the PJM-C being an eco-friendly pesticide and also very effective in managing the above diseases and yield increase can be recommended.

Collection, evaluation and improvement of cucurbits

D.S. Yadav, N. Rai and R.K. Yadav

30 germplasms of bottle gourd, 22 of cucumbers, 13 of pumpkin and 03 of bitter gourd have been collected from different parts of the country and their evaluation under Meghalaya conditions is under progress.

The efficacy of different concentrations of soil applied paclobutrazol for increasing yield of bottle gourd was studied. Among the concentrations Paclobutrazol at 150 and 175 mg/1 were found the best treatments for improving yield and quality of bottle gourd.

Nine treatments of plant growth regulators namely Paclobutrazol and malic hybrazide were given in bitter gourd at two true leaf stage as soil drenching around the plant. Among the PGRs, paclobutrazol 100 mg/1 and malic hydrazide 200 mg/1 were found the best treatments for increasing yield.

Chow-chow

Eight germplasms were collected from different parts of the country and it was found that the germplasms of chow-chow have wide range of variation in morphological and biochemical features of plants and fruits, which ranges in leaf length (10.14 cm), leaf breath (9-18.5 cm); number of flower per cluster (4.8), average fruit weight (63-650 gm) and sprouting of fruit (10-18 days after harvesting).

Collection, evaluation and improvement of Colocasia germplasm

An evaluation trial with twenty eight genotypes of colocasia were conducted at Umiam. Maximum yield (20t/ha) was found in case of Meghalaya Selection, followed by C-3.

Varietal screening in Colocasia

K. A. Pathak, A. N. Shylesha and K. Rajasekhara Rao

25 varieties were screened for the incidence of corm borer *Haplosonyx chlybaeus* Hope. Varieties BCC-1 was found to be most tolerant with 5% infestation where as variety C-149 was found to be highly susceptible. Meghalaya local used as the check recorded 18.33 per cent infestation. Varieties Surya mukhi, BK-Col-1 were found promising with less than 20 per cent infestation.

Collection, evaluation and improvement of sweet potato

In an evaluation trial of thirteen collections of sweet potato, the variety C-43 gave maximum yield of 155.79 q/ha, followed by S-162, which yielded 155.12 q/ha. The maximum length to tuber with light pink colour was found in case of S-107. It was also noticed that varieties with greater diameter and length were found to have cracked surface.

Effect of potassium and FYM on sweet potato

B. Majumdar, M.S. Venkatesh, Kailash Kumar and Patiram

A field experiment was conducted for second year with five levels of K (0, 50, 100, 150 and 200 kg K₂O/ha) and two levels of FYM (0 and 5 t/ha) to study the response of sweet potato to K

and FYM application. The results revealed that the tuber and straw yield, N, P and K uptake increased significantly up to 100 kg K₂O/ha. Available K increased significantly with increasing doses of K. 100 kg K₂O with 5 t FYM/ha was the optimum dose for production of sweet potato.

Acceptability of tomato fruits stored in ambient temperature

A. Nath, N. Rai and D.S. Yadav

Two hundred tomato fruits of variety S-1 (EC-160193XHS-101) were harvested at pink stage and kept in room temperature (22±2°C) and RH 75-80% in CRD design. Changes during storage period was observed at three days intervals in respect of TSS, acidity and percentage weight loss. Observation on changes was continued up to full decay of the fruits. Present study revealed that minimum changes in TSS, acidity and weight loss up to 12 days with its maximum limit for acceptability.

Standardization of carrot tuti-fruti

A. Nath, K.D. Babu and D.S. Yadav

Carrots tuti-fruti was given blanching treatments such as 5 min, 10 min and 15 min by dipping the pieces in boiling water. Amongst the all treatments the product having blanching treatment for 10 min, TSS 70 °B and acidity 1.2 per cent scored the highest overall acceptability among the other treatments.

Osmotic dehydrated carambolla

A. Nath

Four different thicknesses of carambolla slices were made such as 0.5, 1.0, 1.5 and 2.0 cm, for preparation of osmotic dehydrated carambolla slices. From this experiment, it was found that higher thickness of the slices required more times for making dehydrated slices by this method. But, slices thickness 1.0 cm scored

highest organoleptic score and also having good mouth feel than the other slices' of different thickness.

SPICES

Improvement of ginger and turmeric

D.S. Yadav

An evaluation trial was conducted on thirty varieties of ginger. The plant height, number of tillers, rhizome yield/clump, rhizome yield/ha was 45.73-77.2cm, 3.2-11.91, 75.3-412.5g and 7.5-25.2 t/ha, respectively. The highest yield was found in case of Nadia, followed by China.

Forty-three varieties of turmeric were grown and evaluated for number, length, width and weight of mother, primary and secondary rhizome. The highest number of primary rhizome (13) was found in Ca-1/146/4 and higher number of secondary rhizome (10) was also found in case of CA-1/146/4. The length of primary and secondary rhizome varies from 4.1-13 cm and 1.8-8 cm, respectively. The weight of mother rhizomes also varied from 15-90 gm. The yield of fresh rhizome varied from 8t/ha (Kasturi Janaka) to 37.5 t/ha (RCT-1) while the yield of Lakadong was found 30t/ha.

Effect of P sources, FYM and mother rhizome removal in ginger

M.S. Venkatesh, B. Majumdar, Kailash Kumar and Patiram

Results revealed that application of rock phosphate @ 100 kg P₂O₃/ha in conjunction with FYM resulted in maximum fresh rhizome yield (25.58 t/ha). Effect of mother rhizome removal was negative but not significant.

Effect of levels of N and FYM on the yield and nutrient uptake of turmeric (cv.

B. Majumdar, M.S. Venkatesh, Kailash Kumar and Patiram

In a field experiment conducted during kharif

2000 for second year with 6 levels of N (0,30,60,90,120 and 150 kg/ha) and 2 levels of FYM (0 and 5t/ha), the rhizome yield and N uptake by rhizome increased significantly with increase in N levels up to 90 kg/ha and thereafter with the increase in N levels the rhizome yield reduced and there was no significant increase in N uptake also. The highest rhizome yield (18.5 t/ha) and N uptake were recorded at N₉₀FYM₅ treatment combination.

Response of ginger to N, FYM and mother rhizome removal

B. Majumdar, M.S. Venkatesh, Kailash Kumar, Patiram and B. Lal

Field experiment was conducted during *kharif* season of 2000 to find out the effect of levels of nitrogen (0, 50 and 100 kg/ha), FYM (0 and 5 t/ha) and mother rhizome removal on the yield and nutrient composition of ginger grown on an acid soil. The results revealed that the rhizome yield of ginger increased significantly with increasing levels of N and FYM and the yield was non-significantly higher with the mother rhizome removal in comparison to plots where mother rhizomes were not removed.

Effect of P sources and FYM on yield and nutrient content of turmeric

M.S. Venkatesh, B. Majumdar, Kailash Kumar and B. Lal

Results revealed that combined application of rock phosphate + SSP (1:1) @ 100 kg P_2O_5 / ha in conjunction with FYM resulted in maximum fresh rhizome yield (11.36 t/ha).

Effect of phosphorus and sulphur in garlic

B.Majumdar, M.S.Venkatesh, Kailash Kumar and Patiram

A field experiment was conducted for second year on an acid soil with 4 levels of S (0,10,15 and 20 kg S/ha) and 3 levels of P (0,50 and 100 kg P_2O_5 /ha) to find out their effect on yield and nutrient composition of garlic. The results revealed that there was significant increase in

the yield of garlic with increasing levels of P and S and a synergistic relationship was found between P and S for bulb yield of garlic and nutrient uptake.

PASTURES AND FODDER PRODUCTION

Effects of incubation of live yeast with feed ingredients on their nutritive value

S.K. Sahoo, B.P.S. Yadav and J.J. Gupta

An *in-vitro* fermentation study was conducted to find out its beneficial impacts on nutritive value of feed ingredients. Incubation of feed ingredients like wheat bran, broken rice, mustard oil cake and mixed feed with live yeast culture for 48 hours at 37°C, increased the protein content of feed from 3.33 (mixed feed) to 10.53 (wheat bran) per cent. However, the beneficial effects can be assessed only after the metabolism trial.

Production potential of groundnut fodder

J.J. Gupta and B.P.S. Yadav

The groundnut (*Arachis hypogaea*) fodder of AG-1 variety collected from IGFRI, Jhansi was transplanted last year in 100m² area to study its production potential. Total four cuts were taken this year. Total fresh fodder yield 50.28 t/ha was recorded with average 23.44% DM content. The pooled dry sample of all four cuts was analyzed, which exhibited 17.01% protein, 32.48% fibre, 1.00% ether extract, 7.98% total ash, 1.47% calcium and 0.43% phosphorus. Thus, it may be a good potential fodder for livestock feeding.

Production potential and nutritive value of buckwheat

J.J. Gupta and B.P.S. Yadav

Buckwheat (Fagopyrum esculentum Moench) seeds were collected from NBPGR Regional Station, Umiam and sown in 100m² area. The

soil was enriched before sowing with FYM @ 5 t/ha. The crop was sown successively two times in the same plot after the gap of 20 days of first crop harvesting. Performance of crop sown in different periods is given in Table 3.

Table 3. Performance of buckwheat sown in different periods

Particulars	Performance in o	lifferent periods
	July-August	SeptNov.
Cropping period (d)	75.0	62.0
Seed rate (Kg/h)	32.5	41.7
Germination (%)	90-95	90-95
Av. Plant height (cm) 110-135	60-70
Seed yield (q/h)	6.38	7,71
DM % in seed	77.0	81.0
Coat to grain ratio	2.62	2.75
Nutritive value (g/100g DM)	Corticated	Decorticated
A STATE OF THE STA	10.81	12.86
Crude protein	16.96	4.38
Crude fibre		2.62
Ether extract	2.11	
Total ash	2.07	2.39
The second second		SCHOOL STATE
Calcium Phosphorus	0.40 0.30	0.58

Thus, results revealed that buckwheat might be a good non-conventional and potential feed resource for livestock and poultry feeding.

Nutritional profile of underutilized crops

D. Agrahar-Murugkar and B.K. sarma

Underutilized crops such as soybean, rice bean, high quality maize, finger millet, buck-wheat and amaranth were studied for differences in nutritional quality between genotypes of each variety. Four varieties of soybean, 9 varieties each of finger millet and quality protein maize, 11 varieties of rice bean and one variety each of amaranth and buckwheat were analyzed for dry matter, crude protein, ether extract, ash, calcium and phosphorus. No significant differences were

seen in the nutrients between the varieties studied. However, the crude protein in quality (protein) maize ranged from 10.08 gm% to 10.97 gm% while it had ranged from 8.24 to 8.72 gm% and 23.79 to 27.25 gm% in finger millet and rice bean, respectively.

PIG

Genetic improvement of selected indigenous pig with Hampshire

Anubrata Das, S. Naskar, G. Kadervel and S.K. Das

The study was undertaken by crossing the selected indigenous pig of Meghalaya with Hampshire. A total of 44 farrowing from 30 F, generation was produced during the period. The litter size at birth and weaning was 6.57 ± 1 2.31 and 5.82±2.26, respectively. The litter weight at birth was 6.38 ± 2.65kg and individual weight at birth was 0.95±0.16kg. However, in male it was highest 0.93±0.24kg in comparison 0.89±0.23kg in female. The litter weight at weaning was 36.31 ± 12.82kg. But the individual weaning weight was highest 6.16±2.47kg in female. The post weaning daily body weight gain was 124,21 ± 28.87g. The age at first farrowing was 257.45 ± 54.63 days and interfarrowing interval was 242.15±24.23 days.

In commercial 87.5% inherited crossbred pigs, a total of 20 number of farrowings were observed where the litter size at birth was 8.28 ± 2.14 and litter weight at weaning was 7.40 ± 1.67 . The individual weight at weaning was 8.05 ± 1.65 for male and 7.67 ± 1.61 kg in female. The post weaning daily weight gain was 150.65 ± 25.55 g and inter farrowing interval was 211.50 ± 15.25 days. (Table 4.)

Improvement of local pigs

Anubrata Das, S. Naskar, G. Kadirvel and G. Khargharia

In NATP scheme, the survey was done in different villages of East Khasi Hills, West Khasi Hills, Jaintia Hills and Ri-Bhoi district and a total of 30 khasi local piglets (20 females and 10 males) were procured from the remote villages of Meghalaya. They were kept in same managerial system. During the period under report, 6 sows farrowed and produced F, generation. The productive performance of the local pig of Meghalaya is presented in Table 5.

Table 5. Productive performance of local pig of Meghalaya

Trait L	ocal pig of Meghalaya
Litter size at birth	6.000
Litter weight at birth (kg)	3.228
Individual weight at birth (kg)	0.538
Litter size at weaning	3.000
Litter weight at weaning (kg)	11.295
Individual weight at weaning	(kg) 3.725

Jai Vigyan National Science and Technology Mission on HFNS for tribal, backward and hilly area-integrated piggery development

Anubrata Das, S. Naskar, G. Kadirvel and S.K. Baishya

The improved pigs were distributed among the farmers of 8 villages including 4 cooperatives. A total of 224 numbers of piglets were distributed during the period under report. Out of the 224 piglets, 192 piglets were given to 64 beneficiaries covering 8 villages namely Umsaw,

Table 4. Growth performance of crossbred (87.5 % Hampshire inheritance) and Khasi local pigs

Parameters Pillery box Him regulation (box	Crossbred pigs	Khasi Local pigs
Number of animals	75	75
Average initial body weight at 3 months of age	9.37±0.87	5.15±0.95
Average body weight at 6 months of age	17.92±4,88	8.19±1.67
Average body weight at 1 year of age	41.17±8.77	20.94±3.85

Pyllun, Mawkriah, Nongumlong, Sohrieblei, Kyrdem, Nongkrem and Pomlum with the remaining 32 piglets, 4 breeder units were established under 4 societies, *i.e.*, Multipurpose Agricultural School, Mawlendep, Maring Society, Raplang, Sohrieblei, RRTC, Umran and Khyrim Self Employment and Development Society, Nongkrem.

Input service in the form of feed and veterinary medicine/vaccines were also provided to these beneficiaries. During the period, a total of 6.04 MT of pig feed was distributed alongwith feed additives like Hostacycline and Agrimin.

Mortality percentage in the distributed pigs was 12.5% and on average, growth rate of 150g/day was recorded in the pig distributed with a range of 100 to 300g/day.

Performance assessment of introduced technology in livestock productivity

P.P. Pal, S. Naskar N. Prakash and Rajesh Kumar

The comparative growth performance under existing pig rearing practices presented in the Table 5. Gain in body weight of the introduced breed has been quite encouraging both at 6 months as well as at one year of age. The overall performance showed the developed breed of pigs can be reared in any condition. Pigs are very much responsive to local feed if supplemented with additional ration in terms of gain in body weight. Mortality rate of the improved breed can be brought down to negligible percentage if proper health care measures are administered. Whereas, the local breeds are quite susceptible to other diseases like pneumonia and diarrhoea.

Adoption of improved pig rearing practices among the tribal farmers

Rajesh Kumar, B. Bihari, Kamta Prasad, P. Sundarambal and P.P. Pal

The study revealed that the most of the farmers belong to middle age category, medium family size and low educational status. Among



Pig rearing at village level

the breeding practices, heat detection and symptoms identification was done by majority of the farmers in all the states. Regarding other practices like maintaining of boar for breeding purpose, breeding of female piglets was done by very few farmers in time. Among the feeding practices, majority of the farmers were allowing the pigs for scavenging and followed by evening ration. It is seen that healthcare system is totally uncommon in the rural areas. The major constraints faced by the farmers were absence of healthcare facilities (90.80%), non-availability of crossbred pigs in local market (76.80%), cost of feed (60.80%), susceptibility of improved breed to diseases (80.40%) and lack of knowledge about better management practices (79.20%).

Pig management practices

Rajesh Kumar, P.P. Pal, N. Prakash, and S. Naskar

The farmers of this region mainly rear 2 to 4 local breed of pigs in their own way. High mortality and morbidity alongwith low growth rate are the common feature in the entire region. A study in the existing management practices of pig rearing (among 250 farmers) in Arunachal Pradesh, Assam, Manipur, Meghalaya and Nagaland has shown that only 10% of the farmers are rearing cross-bred pigs, locally available feed materials and the kitchen waste

are fed once in a day, followed by free grazing except in Manipur where most of the farmers (62.00%) follow the stall feeding of pigs.

Performance of pigs on rice polish based with soya flake as source of protein

B.P.S. Yadav, S.K. Sahoo and J.J. Gupta

A feeding trail for the period of 72 days was conducted on crossbred (Hampshire x Local) weaning pigs on the rice polish (75%) based diets in combination with soya meals as protein source with (T3) and without (T2) fishmeal. The supplementation of fishmeal did not show any significant effects on growth performance of pigs. The pigs gained 343-g/d growth rates on diet T2, which was significantly not lower than control diet (T1) 406 g/d. Thus, it is concluded that rice polish can be incorporated up to 75% in pig ration with soya meal as source of protein without any adverse effects on growth and nutrient utilization.

Prevalence of Cysticercus cellulosae in pigs

C. Rajkhowa and S. Bandyopadhyay

The prevalence of Cysticercus cellulosae was noticed in 14 pigs out of 225 sampled. Cysts were commonly observed in the muscles of shoulder, thigh, undercut neck region and tongue of the animals, whereas, 9 of pigs had hydatid cysts.

Bacterial of Public Health importence transmitted through Meat

Ashok Kumar, H. V. Murugkar, and I. Shakuntala.

A total of 32 pork samples from different locations of Shillong were procured and processed aerobically in the laboratory to evaluate their bacteriological profile of public health significance. Thirty-two pork samples were procured from Umpling (3), Laitumkhrah (7), Laban (5), Mawlai (5) and Barabazar (12). The total viable count (TVC) and the mean differential counts of various organisms for all the samples examined are shown in Table 6. Listeria sp. was also isolated from 8 pork samples (Table 6).

The isolates when subjected to antibiogram studies against 16 antibiotics showed a varying pattern of drug sensitivity. However, all the isolates showed sensitivity to Norfloxacin, Enrofloxacin, Gentamicin, Ciprofloxacin, Tetracycline, Trimethoprim and Streptomycin, whereas all but one *S. typhimurium* isolate was sensitive to Nalidixic acid and Chloramphenicol.

Diagnosis and Control of Piglet Mortality

H. V Murugkar, Ashok Kumar, I. Shakuntala, B. R. Shome, Rajeswari Shome, and S. Naskar

Salmonellosis in piglets

A total of 136 diarrhoeic piglets were screened for the presence of *Salmonella* at various organized and unorganized farms. The faecal samples were inoculated in Brilliant Green Tetrathionate broth and subsequently inoculated on Modified Brilliant Green Agar. A total of 21 samples were found to be positive for *salmonella* sp. The isolates were sent to National *Salmonella* and *Escherichia* Center, Kasauli for serotyping. Out of 21 isolates, eleven belonged to *S. typhimurium* 4,5,12:1:1,2, eight to *S. enteritidis* 9,12:g,m and one each to *S. bareilly* 6,7:y:1,5 *S.*

Table 6. Mean TVC and differential counts of pathogenic bacteria for the pork samples

Location	TVC (cfu/g)	Coliform (cfu/g)	Faecal streptococci (cfu/g)	Staphylococci (cfu/g)
Umpling(8)	2.89x104	7.11 x10 ³	27.64 x10 ³	4.6 x10 ³
Laitumkhrah(7)	0.91 x10 ⁴	4.79 x10 ³	19.06 x10 ³	8.54 x10 ³
Laban(5)	6.3 x10 ⁴	7.36 x10 ³	12.84 x10 ³	1.49 x10°
Mawlai (5)	6,49 x10 ⁴	6.59 x10 ³	21.17 x10 ³	3.89 x10 ³
Barabazar (25)	6.65 x10 ⁴	15.22 x10 ³	22.32 x10 ³	15.49 x10 ³

paratyphi B 4,5,12:b:1,2 serotypes.

Antibiogram studies of all the isolates revealed a varying pattern of drug sensitivity. However, all the isolates were found to be sensitive to Norfloxacin, Kanamycin, Enrofloxacin, Ciprofloxacin, Trimethoprim and Streptomycin. Based on the antibiotic sensitivity studies, effective treatment and control measures were recommended.

Characterization of Salmonella enterotoxin

Enterotoxin is a major virulence factor involved in the pathogenic process of Salmonella infection in animals and human beings. A partially purified Salmonella enterotoxin has been prepared and is being further purified and characterized with the help of Gel Filtration Chromatography and Polyacrylamide Gel Electrophoresis. Antiserum against the partially purified enterotoxin was raised in rabbits and is being used to carry out further characterization of the toxin and to determine the ability of enterotoxin production by the field Salmonella isolates which were isolated from meat, poultry, pigs and human.

Colibacillosis in piglets

Out of 50 rectal swabs collected from different breeds of piglets, 45 *E. coli* were isolated. The *E. coli* isolates belonged to 22 different serotypes, out of which 06, 065, 08, 09, 0107 and 0101were predominant. *In-vitro* antibiotic sensitivity test revealed that 91% and 84% of isolates were resistant against tetracycline and ampicillin, respectively. Highest sensitivity was recorded against gentamicin and Chloramphenicol (100%) followed by Enrofloxacin (86%) and Doxycycline (71%). Based on the antibiotic sensitivity studies, effective treatment and control measures were recommended.

Anaerobic bacteria associated with piglet diarrhoea

A total of 40 rectal swabs were screened for the presence of anaerobic bacreria to determine the etiological agent for chronic diarrohea in piglets where the mortality rate was 2-3%. The samples were processed under strict anaerobic condition by following standard methods. Out of 40 samples screened, four samples were positive for different *Clostridium* sp. and they were identified as *Cl. butyricum*, *Cl. rectum*, *Cl. perfringens* and *Cl. paraperfringens* based on their morphological, cultural and biochemical characteristics. The presence of *Clostridium perfringens* cannot be overlooked because *Clostridium perfringens* type C is recorded in suckling piglets causing enterotoxaemia during the first week of life.

NATP-CGP "Development of DNA based diagnostics for important livestock and poultry diseases in NEH region".

B. R. Shome, Rajeswari Shome, M. Rahman and N. D. Verma

Analysis of *Escherichia coli* for plasmids and polypeptide profiles

Eight numbers of Escherichia coli isolates from pig, belonging to five serogroups 08 (3), 06 (3), 020 (1) and 0119 (1) were analysed for plasmid and polypeptide profiles(Fig. 1 & 2). Plasmid analysis of the isolates showed presence of multiple plasmids in all the eight potential toxigenic E. coli isolates with a common plasmid at 23.14kb. The common plasmid was most predominant in all the strains with an amount ranging from 23% to 72%. Dendogram of overlayed graph based on plasmid profile similarity using Pearson product at 4% autofit showed similarity ranging from 64.75% to 91.53%. These eight isolates were further tested for their toxinogenic potential. Four strains belonging to 08 (2), 06 (1) and 020 (1) were found to be highly toxigenic. Interestingly, all of these toxigenic strains were found to exhibit most common antibiotic resistance pattern T+Cr+A+Cx+G-C Ex . Comparative plasmid profile analysis indicated that the likelihood of the presence of genes coding for toxin(s) is in the common plasmid of 23.5-26kb.

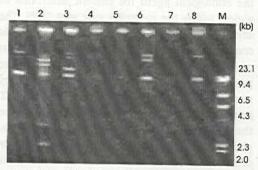


Fig. 1 Plasmid profile of *E. coli* strains isolated from diarrhoeic piglets - Lane 1 to 8; M is the marker in Kilobases; Cat No. MBD2S, *Bangalore Genet*)



Studies on general and specific combining abilities of rabbit

Anubrata Das, S.K.Das, S. Naskar and G. Kadervel

The study was undertaken by diallel crossing involving New Zealand White (NZW), Soviet Chinchilla (SC) and Local (L). The productive and reproductive performance of six genetic group, i.e., NZW X SC (NS), NZW X LC (NL), SC X NZW (SN), SC X LC (SL), LC X NZW (LN) and LC X SC (LS) are as follows:

The litter size at birth was highest 6.00±0.21 in NS and lowest 5.32±0.20 and 5.33±0.36 in SL and LN groups, respectively. However, in the other groups, the litter size are almost similar. The litter size at weaning was highest 5.55 ± 0.30 in NS and lowest 4.50±0.93 in LN group. Litter weight at weaning was highest 3573.26±18.27g in NS and lowest 2691.41 ±21.22g in LN group. However, the individual weaning weight for male was highest 691.33±17.37g in NL and lowest 593.91 ±21.79g in LN. In female, it was highest 668.70±20.08g in LS and lowest 592.08± 21.55g in LS group. However, at 90 days, average individual weight was highest 1730.28±30.79g in NS and lowest 1428.88±34.30g in SL group. But in male it was highest 1750.67±30.71g in SN and female it was 1725.56±38.34 in NS

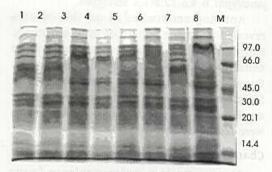


Fig: 2 Whole cell polypeptide profile of *E. coli* isolated from piglets (Lane 1 to 6 - isolates of *E. coli*; M is the Marker, Cat No.17-0446, *Amersham Pharmacia* Biotech.)

group. The lowest weight was found to be 1468.75±35.38g and 1389.00±34.00g in male and female, respectively. Post weaning growth was highest 25.54g in male for SN and 22.71g in female for NS group. Lowest post weaning daily weight growth was observed in SL group for both male and female.

The trial on productive traits of pure breed rabbit involving NZW, SC and LC are presented in Table 7. The litter size at birth was highest in SC, followed by local and NZW. Similarly litter size at weaning was highest in SC, followed by local and NZW. However, litter weight at weaning was almost similar in NZW and SC. Individual weight at 90 days for male and female was highest in NZW, followed by SC and Local. Post weaning growth rate was highest 20.63 g in male for NZW and 20.67 g in female for local rabbit. The carcass trait of different genetic group showed the dressing percentage as 52.50 ± 0.75 in SN and lowest 50.73 ±0.70 in SL group and in other combination group the dressing percentage was almost similar.

Improvement of broiler rabbit for meat

S.K. Das and K.C. Barman

20 New Zealand White and 20 Soviet Chinchilla rabbits were procured for the study. Productive and reproductive performance of the rabbits are as given in Table 8.

Table 7. Productive traits of pure breed rabbit

Traits	AND THE PERSON NAMED IN	Breeds of rabbit	
	NZW	SC	LC
Litter size at birth	5,39±0.14	5.76±0.18	5.40± 0.27
Litter wt. at birth (g)	568.79±12.94	564.39±13.08	399.00±37.49
Individual wt. at birth (g)	105.53±2.01	97.98±2.44	73.89±1.38
Litter size at weaning	4.66±0.21	4.88±0.26	4.80±0.36
Litter wt. at weaning (g)	650.83±9.65	638.34±10.15	513.37±15.01
Individual wt. at weaning (g)			
Male	663.56±11.37	662.76±10.16	537.33±21.95
Female	638.10±11.96	613.91±12.33	489.41±25.34
Post weaning growth (g)			
Male	20.63±11.37	18.76±10.16	18.96±20.95
Female 20 228 01 10 10 10	20.28±11.50	20.30±10.55	20.67±20.21
Individual wt. at 90 days (g)	- Approximation		
Male	1653.78±23.35	1563.41±41.25	1447.62±43.15
Female	1611.33±23.89	1588.41±33.74	1481.67±56.89
Individual wt. at 120 days (g)			
Male	2297.78±30.20	1999.39±23.43	1780.00±40.27
Female	2189.70±17.96	2144.76±21.76	1837.50±47.47
Individual wt. at 180 days (g)			
Male	2606.92±30.62	2300.26±22.07	2018.18±32.73
Female	2479.67±30.87	2401.15±32.00	2063.35±31.85

Table 8. Productive and reproductive performance of rabbits

Parameters	SC	NZW
Litter size at birth	6.12±0.61	5.98±0.57
Individual litter weight at birth	80.12±0.52	81.72±1.04
Litter size at weaning	5.12±0.12	4.98±0.19
Litter weight at weaning	3.063±0.13	3.710±0.10
Live weight at 90 days	1.506±0.07	1.48±0.05
Average daily gain (g/d)	17.03±0.32	15.37±0.28
Average daily feed intake (g/d)	68.40±0.16	67.83±0.16
Feed conversion ratio	4.02±0.36	4.41±0.38
Live weight at 180 days	2.456±0.115	2.44±0.10
Age at first conception (d)	271.00±17.00	221.00±12.00
No. of service per conception	2.40±0.48	1.79±0.32
Interkindling period (d)	64.00±9.00	82.00±5.00

Growth performance and carcass yield of NZW rabbit fed rice bean fodder

D. Agrahar-Murugkar, J.J. Gupta, B.P.S. Yadav and A. Das

An experiment of 21 days duration was conducted on 46 days old weaned NZW rabbits to evaluate nutritive value of rice bean fodder. Total 40 rabbits were distributed in to 5 groups, which were offered 80, 70, 60, 50 and 25 gram concentrate pellets, respectively, per day per rabbit and ad-libitum amount of rice bean fodder by cut and carry method. The DM intake ranged from 50.16 to 68.21 g/d, and the growth rate varied from 16.67 to 22.61 g/d respectively. There was no significant difference in growth rate was observed in rabbits fed concentrate pellets 60-80 g/d. similar types of trends were noticed for nutrient utilization. The carcass yield was recorded 65-70% and bone percentage in meat varied from 16.43 to 20.48%. Thus, it is

concluded that concentrate pellet can be saved up to 25% by feeding of rice bean fodder to grow NZW rabbit.

Diagnosis and control of bacterial disease under intensive rabbit rearing system

I. Shakuntala, H.V. Murugkar, A.Kumar, B. R. shome, R. Shome and A. Das

Screening for rabbit diseases

Screening of the major pathogenic bacteria harboured in the upper respiratory tract of the rabbits was carried out. Nasal swabs of the 108 rabbits, which comprised of 72 healthy rabbits, 36 suffering from respiratory distress showing symptoms of coughing, sneezing and dyspnoea with nasal and ocular discharges were examined. Staphylococcus aureus was the most common species and was isolated from 32 healthy rabbits and 18 with respiratory problems. Bordetella sp. was isolated from 20 healthy rabbits, 14 with respiratory problems in the form of single or mixed infection with S. aureus or Streptococcus sp. (Table 9).

Table 9. Bacterial pathogens isolated from the upper respiratory tract of rabbits

Bacterial isolates	Healthy rabbits	Respiratory distress
Staphylococcus aureus	22 (30.6%)	14 (38.9%)
Bordetella sp.	5 (6.9%)	6 (16,7%)
Bordetella sp.+S. aureus	10 (13.9%)	4 (11.1%)
Streptococcus sp.	3 (4.2%)	1 (2.8%)
Streptococcus sp.+B. sp.	5 (6.9%)	4 (11.1%)
Diplococcus	2 (2.8%)	1 (2.8%)
Staph. Epidermidis	12 (16.7%)	2 (5.6%)
Bacillus sp.	5 (6.9%)	
Other unidentified	8 (11.1%)	4 (11.1%)
Total	72	36

Post-mortem examination

Post-mortem examination of rabbit carcasses received from the ICAR Rabbit Research Farm & nearby villages in cases of mortality was conducted to ascertain the cause of death. A total of 29 rabbit carcasses were examined for causes

of mortality. The necropsy findings revealed that highest mortality was due to pneumonia (51.7%), followed by trauma (20.7%), nephritis (17.2%) and peritonitis (10.3%). The samples from affected organs were subjected for detailed bacteriological investigations to find out the involvement of etiological agent(s). A total of 30 bacteria could be isolated and identified as Staphylococcus aureus (9; 30%), Bordetella bronchiseptica (6; 20%), Escherichia coli (6; 20%), Proteus sp. (3; 10%), Bacillus sp. (3; 10%), Pseudomonas sp. (2; 6.7%), and Arizona sp. (1; 3.3%). The results were communicated to competent authority to take necessary precautions.

Pathogenicity test

As the disease involving respiratory system were recorded to be the main cause of mortality (51.7%) in rabbits, isolates obtained from lung samples were tested for pathogenicity in mice. Intra-peritoneal injection of 0.25 ml of overnight culture of *Bordetella bronchiseptica*, *Staphylococcus aureus* and *Pseudomonas* sp. was found to be highly fatal to mice that died due to septicaemia with pneumonic lesions in lungs. The same bacteria were isolated from the heart blood and lung samples of the respective mice.

CATTLE AND GOAT

Performance of goats on Makri sal (Schima wallichii) leaves and in native pasture

S.K. Sahoo, B.P.S. Yadav and J.J. Gupta

The goats were allowed to graze for 6-8 hours daily in the pasture for the period of 90 days. The growth rate was found 32.22±4.23 g/d, which was satisfactory. However, when the same grass was fed as cut and carry method (stall feeding), the growth rate was 36.11±2.78 g/d. Hence feeding of makri sal leaves is not advisable due to very poor palatability. The

Table 11. Pattern of gastro- intestinal parasites of cattle in Meghalaya

Month	Place	Samples	Samples	Sam	ples found po	sitive for		EPG
• 14142 A par	examined	found positive	Haemonchus	Trichostro- ngylus	Oesophago- stomum	Toxocara	exulence	
January	US	20	08(40.0)	08(40.0)	06(30.0)	03(15.0)	05(25.0)	200-400
january	THE REAL PROPERTY.	18	03(16.7)	03(16.7)	03(16.7)	01(05.5)	02(11.1)	100-200
	UM	08	01(12.5)	OCUL TO		01(12.5)	-12	100
	Kyr	20	08(40.0)	08(40.0)	05(25.0)	03(15.0)	at nones	100-200
	Total	66	20(30.3)	19(28.8)	14(21.2)	08(12.1)	07(10.6)	misting.
February	US	20	07(35.0)	06(30.0)	05(25.0)	02(10.0)	03(15.0)	200-300
1 COT GOLD	I	21	03(14.3)	03(14.3)	02(09.5)		Mark Street	100-200
	UM	08	02(25.0)	02(25.0)	morrange, i	KD-C/FINDSF	Second Line	100-200
	Kyr	22	07(31.8)	06(27.3)	03(13.6)	bus direct in	i pays nitt	100-200
ortena co	Total	71	19(27.8)	17(23.9)	10(14.1)	02(2.8)	03(4.2)	Marie de
March	US	26	10(38.7)	07(26.9)	06(23.1)		03(11.5)	200-400
141012	1	20	-ve"		ante-loste	odi sei om	DECKE ME	THE
	UM	08	01(12.5)	01(12.5)		franktyll fr	ASSESS!	100
	Kyr	20	06(30)	03(15.0)	04(20)		-	100-200
	Total	74	17(23.0)	11(14.9)	10(13.5)	SWINNESS IL .	03(4.1)	news stre
HE BAT	Total (I	+F+M)	211	56(26.5)	47(22.3)	34(16.1)	10(4.7)	13(6.2)

Figure in parentheses indicate the percentage

EPG- Egg per gram of faeces; J- Jowai (Jaintia Hills District); UM- Umiam (Re Bhoi District); Kyr- Kyrdemkulai (Ri-Bhoi District), US- Upper Shillong (East Khasi Hills District)

Table 12. Incidence of gastro-intestinal parasites of pig in Meghalaya

Month	Place	Samples	Samples	Samp	oles found posi	tive for		EPG
	examined	found positive	Strongyl- oides	Hyostron- gylus	Oesophag- ostomum	Ascaris		
January	T	12	03(25.0)	03(25.0)	02(16.66)	02(16.7)	-ve	100-200
jamon	UM	10	-ve"			A material of	-	
	Kvr	15	03(20.0)	03(20.0)	-ve	-ve	02(16.7)	100-200
	Total	37	06(16.2)	06(16.2)	02(05.4)	02(05.4)	02(05.4)	July 14
February	T.	15	03(20.0)	03(20.0)	01(06.7)	01(06.7)	-ve	100-200
	UM	15	01(6.67)	01(06.7)	-ve	-ve	-ve	100
	Kyr	17	05(29.4)	04(23.5)	-ve	-ve	02(11.8)	200-300
	Total	47	09(19.1)	08(17.0)	01(02.1)	01(02.1)	02(04.3)	of A Lagr
March	TOR THE	17	05(29.40	03(17.7)	03(17.7)	01(05.9)	02(11.8)	200-300
Track Car	UM	20	02(10.0)	02(10.0)	-ve	-ve	01(05.0)	100-200
	Kyr	20	06(30.0)	03(15.0)	02(10.0)	-ve	05(25.0)	200-300
	Total	57	13(22.8)	08(14.0)	05(08.8)	01(01.8)	08(14.0)	boits
Total ([+]	F+M)	141	28(19.9)	22(15.6)	08(05.7)	04(02.8)	12(08.5)	(4)

Figure in parentheses indicate the percentage

EPG- Egg per gram of faeces; J- Jowai (Jaintia Hills District), UM- Umiam(Re Bhoi District), Kyr- Kyrdemkulai (Ri-Bhoi District)

^{*} Most of the positive animals had multiple infection

^{**} Anthelmintic was administered 15 days prior to the collection of samples

^{*} Most of the positive animals had multiple infection
** Anthelmintic was administered 15 days prior to the collection of samples

whereas all but one S. typhimurium isolate was sensitive to Nalidixic acid and Chloramphenicol.

CU PD_ADMAS "Collaborating unit-Project Directorate for animal disease monitoring and surveillance"

B. R. Shome, Ashok Kumar, Rajeswari Shome, H. V. Murugkar, I. Shakuntala, N. Nashirudullah and N. D. Verma

During the year, Division of Animal Health ICAR Research Complex, Barapani, was identified as one of the newly incorporated Collaborating Unit of Project Directorate on Animal Disease Monitoring and Surveillance.

Co-Principal Investigator and Research Associate have undergone the training at PD_ADMAS on ELISA practical aspects. Serum collections from various species have been started and the same is preserved for further analysis. ELISA and dot-ELISA have been standardized. The following diseases were studied:

Outbreak of Foot and Mouth disease in dairy cattle

An outbreak that occurred in the month of January 2001 at the dairy unit was investigated. Preliminary clinical investigation based on the symptoms and lesions gave rise to the suspicion of Foot and Mouth disease. Supportive treatment was given to the animals and the mortality was checked. A detailed investigation with the help of AICRP on FMD, Khanapara, Guwahati confirmed the involvement of "O" serotype of the FMD virus.

Mastitis in dairy cows

Routine screening of milk sample for mastitis was carried out in Dairy unit of ICAR research

complex Umiam. A total of 30 milk samples were collected from the suspected and clinical cases of mastitis to examine for bacteriological profile. Out of 30 milk samples examined, 14 samples showed the presence of mastitis causing bacteria. The bacteria isolated from the samples were Staphylococcus aureus (2), Streptococcus uberis (6), Streptococcus bovis (2) and other Streptococcus species (4). Attempts were also made to isolate Listeria sp. and Campylobacter sp. However, none of the samples were positive for these bacteria. Streptococcus uberis was found to be the most frequently isolated agent and was recorded more during the winter season. Clinical cases were treated successfully with Enrofloxacin based on antibiogram results.

Brucellosis

A total of 16 serum samples from cattle in Upper Shillong Govt. dairy farm and dairy unit of the Institute were screened for the presence of antibodies against brucellosis with the help of STAT (Standard Tube Agglutination Test) and RBPT (Rose Bengal Plate Test). All the samples were found to be negative for *Brucella* antibodies.

NATP-CGP "Development of DNA based diagnostics for important livestock and poultry diseases in NEH region"

B. R. Shome, Rajeswari Shome, M. Rahman and N. D. Verma

Black leg disease of cattle in Manipur

In continuation to the study carried out earlier, the causative agent was further confirmed as *Clostridium perfringens* Type—A by Toxin - Antitoxin assay at Diagnostic Bacteriology Laboratory, NVSL, APHIS, USDA,

Table 13. Mean TVC and Differential counts of pathogenic bacteria for the beef samples

Location	TVC (cfu/g)	Coliform (cfu/g)	Faecal Streptococci (cfu/g)	Staphylococci (cfu/g)
Barabazar (25)	11.94x10 ⁴	19.47 x10 ²	7.96 x10 ⁴	2.55 x10 ³
Umpling (8)	5.9 x10 ⁴	2.44 x10³	23.70 x10 ³	7.56 x10 ⁸

Ames, Iowa. Cultures were analyzed by PCR in Dr. Glenn Songer's lab at University of Arizona, USA. â-2 toxigenic Clostridium perfringens Type A, was found to be responsible for acute myositis (atypical blackleg) cases in cattle of Manipur. In-vitro antibiotic sensitivity test was undertaken which showed that all the strains have common sensitivity pattern of C Mt St but varies with respect to its sensitivity to Nitrofurantoin.

Five cultures were analyzed for plasmid and polypeptide profiles (Fig 3). Plasmid profiles revealed that sample No.1 harbors a single plasmid of 9.5 kb while the rest four samples harbors three plasmids. A common distinct band is visible in the 23.3 + 0.2-kb range in all the four samples, besides two faintly visible plasmids of 7.5 and 5.5 kb respectively.

The polypeptide profiles showed thirteen major polypeptide bands for strain No.1 against fourteen bands for all the other four strains in the molecular weight range of 10 to 105 kD. The major polypeptides of strain No. 1 also differed in their molecular weight from those of the other four strains.

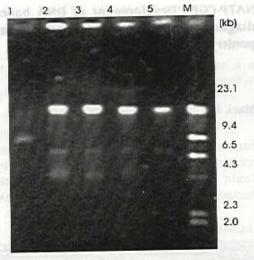


Fig. 3 Plasmid Profile of Clostridium perfringens type A strains isolated from cattle suffering from atypical blackleg Lane 1-6 isolate no.s I, Π_{18} , Π_{1} , Π_{2} Π_{3} , Π_{4} and Π_{6} : M is the marker in Kilobases; Cat No. MBD2S, Bangalore Genet)

Studies on the characterization of β -2 toxin and restriction mapping of the plasmids are under progress.



Supplementation of inorganic phosphorus for improving the conception rate in cows and heifers

S.C. Giri and B.P.S. Yadav

Twenty post- partum anoestrous (PPA) cows and twenty delayed matured (DM) heifers were selected from and around Dairy Unit for the study. Their blood samples were analyzed for inorganic phosphorus, total protein and total cholesterol, which revealed low level of inorganic phosphorus in serum. Subsequently, 30 ml of Tonophosphan in 6 divided doses of 5 ml each was injected to all the animals under study at every 2 year's interval. Response to treatment in terms of exhibition of estrous was found in 90% PPA cows and 80% DM heifers and given to all estrous animals. Half of the PPA cows and DM heifers on estrous were again injected with 15 ml of Tonophosphan (3 divided doses of 5 ml each at 2 days interval) as post A.I. treatment. The conception rate in the post A.I. treatment was higher than the control group of animals in both category of cows and heifers.

estrous of lactating cows: Ten numbers of cows were taken for the experiment. Within 6 hours of parturition, each cow was intramuscularly injected with 5 ml of Prostaglandin F₂ Alfa (Illirin) and its effect was observed till the animal conceived successfully for the next time. It was found that there was no retention of placenta. No cases of post-parturient abnormalities like endometritis/metritis/prolapse of cervix or uterus/mastitis within 20 days of calving was observed. Involution of uterus was normal in all the experimental cows. The average duration of onset of oestrous after parturition was less

than the herd average. The average gestation length was 274.4 ± 1.83 days, average length of lactation- 304.78 ± 10.06 days, average length of dry period- 60.22 ± 10.38 days, average yield per lactation- 2364.8 ± 359.8 liters, average milk yield per day- 8.185 ± 1.21 liters with average calving interval of 374.11 ± 6.74 days, respectively.

FISH

Integration of fishery with horticultural crops

B.K. Mandal, B.K. Mahapatra and K.Vinod

Studies initiated in the Institutional fish farm have shown that cereals like maize, vegetables like frenchbean, cauliflower, cabbage, pumpkin, carambola and curry leaves and fruit crops like papaya, guava, orange, mango, peach, Assam lemon, pummelo and banana and flowers like rose, gladiolus and gerbera can be grown on the dykes and other available farm spaces for a better economic return. The performance of guava was found to be good with an average fruiting of 140 nos/tree/year. The orange trees planted on the dykes yielded about 500 nos. of fruits/tree/year. In two varieties of mangoes planted on the dykes viz., the Madhulika and Amrapali varieties, the performance of the latter was comparatively better.

Induced breeding of Labeo gonius (Hamilton)

B.K. Mahapatra, K. Vinod, W. Kharumlong and B.K. Mandal

Labeo gonius (Hamilton) locally known as Khaski is one of the important carp species having high demand and commercial value. Successful spawning of pond reared L. gonius was observed during June-July months using OVAPRIM as a stimulating agent @ 0.75 ml/kg body weight of fish in the case of males and 1.0 ml/kg body weight of fish in the case of females.

Spawning took place even at a temperature of 19.0 to 21.0°C at an altitude of 900 m. The fishes were given intra-muscular injection at 17.00hrs and spawning occurred within 10 hours of injection. The percentage of fertilization varied from 88 to 94 and hatching rate ranged from 63 to 75%.

Fisheries in Umiam Reservoir

K. Vinod, B.K. Mahapatra and B.K. Mandal

The Umiam reservoir is the largest in Meghalaya having a water-spread area of approximately 500 ha. It has no organized fishery. The main fishing sites are at Dongrylla and at Umniuh where fishing by gill nets (50-60 gill nets in all) is a predominant practice. Another common type of fishing is by angling using hook and line. Cast nets, pen traps, dip nets and drag nets are also used in some parts of the reservoir. The commercial fishery is dominated by Cyprinus carpio var. communis (54.84%), followed by Cirrhinus mrigala (25.91%), Channa punctatus (12.46%), C. carpio var. koi (2.11%), Labeo calbasu (1.51%), Labeo rohita (1.34%), Neolissocheilus hexagonolepis (1.12%), Catla catla (0.56%), Clarias batrachus (0.09%) and Labeo gonius. About 85% of the total catch is being sold at Lad Umsaw and the rest goes to Shillong.

Present status of chocolate mahseer (Neolissocheilus hexagonolepis Mc Clelland) in Umiam reservoir

B.K. Mahapatra, K. Vinod and B.K. Mandal

The chocolate mahseer, Neolissocheilus hexagonolepis (Mc Clelland) locally called as Khasau is a commercially important species of Mahseer group and is widely recognized as a sport fish. The studies on the fish catch composition in Umiam reservoir from April 2000 to March 2001 had shown that the chocolate mahseer contributed a mere 1.12% when compared to the share of 54.84% of common

carp, Cyprinus carpio var. communis to the total fish catch in the reservoir. One of the main reason for the decline in the population of indigenous chocolate mahseer in Umiam reservoir may be due to indiscriminate fishing of brood and juveniles. During the present study, only 26 numbers of chocolate mahseers were recorded from the catches, of which one was a brood fish weighing 5.3 kg while the rest 25 were juveniles weighing as low as 8.0g to 40.0g. The increase in population of Chanda spp., prolific breeding of common carp and pollution from the river Umkrah could be some of the other factors responsible for the decline in mahseer population in Umiam reservoir.

Studies on biology of ornamental danids-Brachydanio rerio and Danio dangila

K. Vinod, B.K. Mahapatra and B.K. Mandal

The Brachydanio rerio (Hamilton) is an important danid fish species commonly found in streams, paddy fields etc. The fish possesses ornamental criteria like four well marked shining gold longitudinal bands from gill cover to caudal fin, the flanks with shining prussian blue colouration, operculum with golden blotches, vellow olive base of dorsal fin and blue gold markings on the anal fin. The females are more silvery and larger in size when compared to males. The belly is swollen in females, especially in gravid ones; whereas in case of males the body is slim. The maximum length observed was 48.0 mm while the maximum weight recorded was 0.95g. Another danid of ornamental value is the moustache danio, Danio dangila (Hamilton) which is also found commonly in streams, paddy fields etc. in all the North Eastern States except Sikkim. The olive back, silvery abdomen and sides with several narrow blue lines which form a beautiful network in the anterior half of the body makes this fish attractive and highly priced in the ornamental fish trade. The males are slender, smaller and brightly coloured when compared to females. The maximum length and weight observed were 62.0mm and 2.37g respectively.

Fecundity of Zebra danio (Brachydanio rerio Hamilton)

B.K. Mahapatra, K. Vinod and B.K. Mandal

The zebra danio is becoming popular among the hobbyists and ornamental fish traders for their bright and exquisite colouration and for their beautiful continuous bands. This species is a prolific breeder and breed mainly from April to August. The fecundity was found to vary from 215 to 1229 and body length and weight ranged from 29.0-37.0mm and 0.20-0.48g, respectively. The relative fecundity ranged from 1075.00 to 2560.42.

POULTRY

Improvement of Backyard Poultry in Meghalaya

N. Prakash, Rajesh Kumar and P.P. Pal

The socio-economic profiles of the selected farmers had shown that most of the farmers (61.66%) are illiterate and belong to middle aged category (70.83%) having medium to small family size, low to medium annual income and very low (50.83%) social participation. This implies that the farmers who really can not afford any other form of poultry rearing stick to small holder backyard poultry farming.

It is observed that lack of government support has been the key factor behind non-improvement of poultry sector as indicated by 65.83% of farmers. The study showed that infrastructural facilities are urgently felt need by most of the farmers (86.66%) followed by credit and training 85.00% and 76.66% facilities, respectively.

Feeding value of groundnut fodder with problotic in broiler chicken

J.J. Gupta, S. Doley, B.P.S. Yadav, S.K. Sahoo and D. Agrahar-Murugkar

A feeding cum metabolic experiment on 14 days old broiler chicks was conducted. Maximum growth rate (g/d) was obtained on control diet (56.24±0.99), which was similar to diet containing groundnut fibre meal (GNFM) at 10% level (51.71±1.80). Maximum feed consumption and poor feed conversion ratio (FCR) was observed in chicken that are diets containing GNFM either at 10 or 15% level. Retention of DM, CP, CF and Ca were not significant between control diet and diet containing GNFM at 10% level. However, the retention of these nutrients was reduced as the GNFM increased to the level of 15%. Thus, it is concluded that GNFM cannot be fed more than 10% level to the broiler chicken even after fortification with probiotic anizyme.

Advantage of probiotics feeding in broiler chicken production

J.J. Gupta, S.K. Sahoo, S.Doley, B.P.S. Yadav and D. Agarwal-Murugkar

The feeding of probiotics in conventional mash diet did not exhibit significant effect on growth rate of chicken. Although, feed consumption was significantly reduced due to probiotics feeding and also resulted enhanced FCR. The probiotic anizyme showed more impact than allzyme vegpro in terms of reduced feed intake, better FCR value and ultimately it lowered the feeding cost for broiler production (Table 14). However, chickens did not show any significant

effect of probiotics feeding on nutrient utilization. Thus, it is concluded that probiotics feeding had advantage in broiler production in terms of lower feed intake, better FCR and less feeding cost. Moreover, the probiotic anizyme is superior to allzyme vegpro.

Performance of broiler chicks under different types of management practices

J.J. Gupta, S. Doley and B.P.S. Yadav

Total 100 broiler chicks were reared from 0-28 days under deep litter in confined brooder room. The birds were offered conventional mash diet (22% CP) and water at ad-lib. The 25 birds were randomly taken and allowed to graze 6-8 hours daily for the period of 21 days in fenced area of groundnut fodder block (T3), after 28 days of common feeding. These birds were provided only water during grazing period. However, after grazing, the birds were again inside the house and offered feed. The other 25 birds taken from previous common group were kept inside the house and provided feed with groundnut fodder (T2). The groundnut fodder was cut daily and spread on the litter twice a day for the period of 21 days. Similarly, another 25 birds were also kept separately inside the house (T1) and provided only feed for the same

The average growth rate (g/d) of birds was recorded 15.63 during first phase (0-28 days) of feeding with FCR value of 3.10. Minimum growth rate was recorded on group T3 (37.62) than group T1 (43.69) and T2 (42.31) in second phase (28-49 days) of experiment. However, feed consumption was not affected and it ranged from

Table 14. Growth performance of chicken fed on probiotics supplemented diets

Particulars		Treatments Mean	s ± SE	CD ±
	Control diet	Anizyme diet	Allzyme vegpro diet	
Growth rate (g/d)	56.18±0.41	56.24±0.91	56.43±0.91	NS
Feed Conversion Ratio (FCR)	2.15±0.30°	1.77±0.09"	2.08±0.04 ^{ab}	0.31**
Feed cost/Kg body Wt. gain (Rs.)	21.91±0.30b	18.69±0.93*	22.35±0.48 ^b	2.19*

Different superscript in row differs significantly (P<0.05)*/ (P<0.01)**

125.00-127.93 g/d. The FCR value was also more for group T3 (3.32) than groups T1 (2.93) and T2 (3.02).

Thus, from this experiment, it revealed that grazing of commercial broiler birds or providing fresh groundnut fodder did not show any beneficial impact on growth rate as well as saving of feed consumption.



Survey and Serveillance

K .A. Pathak and D. Kumar

The rodent activity was highest in August (69.34% active burrows) to October (62.74%) and lowest in February (16.85%). The highest numbers of active burrows were recorded in upland cultivated areas. Like previous years *Bandicota bengalensis* was recorded as predominant species in fields (90,36 % of total population) as well as in urban areas.

Damage assessment

Damage to maize cobs varied between 5.30-10.27 % at various locations in Barapani farm. The maximum 4.32-9.76% active burrows were recorded in the month of August-October.

Lowland paddy suffered losses of 5.00-11.39%. Burrows were recorded on bunds and in surrounding areas till water logging inside fields. At harvest, when water was drained out from the fields, rats make their burrows in the fields.

Management in farm fields

Racumin ready to use bait as well as fresh bait (0.0375%) prepared by using racumin tracking powder and difethialone (25 ppm) was found effective and at par in controlling the rats in fields. Placement of racumin and difethialone bait near burrow openings and on bunds in field for 3-4 days continuously resulted in cumulative reduction in number of active burrows upto 81.34% and 79.86%, respectively. Consumption of bromadiolone bait was fairly low in comparison of racumin and difethialone and resulted in 32.25% reduction in active burrows. Highest reduction in active burrows was recorded by using zinc phosphide (2%), followed by celphos @1-2 tablet per burrow.

Comparative efficacy of anticoagulant rodenticides revealed that maximum reduction in active burrows (81.07%) was recorded when racumin and difethialone were kept at alternate bait stations with per cent consumption of 29.63 and 25.12, respectively. Consumption of bromadiolone in combination with racumin and difethialone was 11.42% and 10.63%. respectively, which is fairly low in comparison of other two anticoagulants (Table 15). Cumulative reduction in no. of active burrows recorded was 79.81%, 82.34% and 82.65%, respectively after baiting of racumin for 1, 2 and 3 days. The Bandicota bengalansis, which is that predominant species in fields, was highly susceptible to racumin bait.

Table 15. Efficacy of rodenticides at various locations in fields

Rodenticides	% consumption of rodenticides	% reduction active burrows
Racumin bait (0.0375%)	42.63	81.34
Bromadiolone wax cake (0.005%)	19.41	32.25
Difethialonn (25 ppm)	42.75	79.86
Zinc phosphide (2%)	21.44	86.21
Celphos @ 2tab/burrow		92.65
Zinc phosphide (2%) followed by celphos	18.31	96.32
Racumin + Bromadiolone	46.35 + 11.42	79.34
Racumin + Difethialone	29.63 + 25.12	81.07
Difethialon + Bromadiolone	42.51+ 10.63	78,23

Management in urban areas

Use of anticoagulants was found very effective for rat control in houses, shops and godowns in urban areas. Racumin and difethialone baits were consumed at par (46.23% and 45.51%) and effective control was achieved within 10 days after 2 days poison baiting. Consumption of bromadiolone wax blocks was very low and effective control of rats could not be achieved even after 3 days treatment. Though the effective control of rats, by using zinc phosphide was achieved by one-day exposure only but being highly toxic its use was not recommended in urban areas. All the combinations of rodenticides proved effective but consumption of bromadiolone wax blocks was 12.39% and 10.61% when placed at alternate bait-stations with difethialone and racumin, respectively (Table 16).

Social Engineering

Approximately 8kg of racumin ready to use bait and bait prepared by racumin tracking powder was distributed for use in houses and shops. It was revealed that approximately 40-50% poison bait was consumed in one night and effective control of rodents was achieved within 8-10 days.

A new formulation of racumin, *i.e.*, racumin paste is under trial in laboratory. Initial findings on no-choice test reveals that poison bait is quite effective against *Bandicota bengalensis*.

AGRICULTURAL ENGINEERING

Evaluation of management practices for biogas production

K.N. Agrawal, S.K. Sahoo and C.S. Sahay

The study was conducted with pig slurry and rabbit waste. The average biogas production reduced 37.8% with reduction in average minimum temperature from 18-9.3°C. The biogas production from rabbit waste was found more than pig dung.

Characterization of prototypes

R.K.P. Singh, K.K. Satapathy and P.K. Sharma

Prototype for which characterization has been done includes PAU manual, wheel hoe, PAU manually operated seed drill, tubular maize sheller, octagonal maize sheller, groundnut decorticator, pedal paddy thresher and motorized wire loop paddy thresher.

Anthropometric studies of agricultural workers of Meghalaya

R.K.P. Singh and K.K. Satapathy

Results showed that body dimensions of the agricultural workers of Meghalaya are significantly different than their counter parts of the country. The data will help in design modification of existing improved tools and implements to make it suitable for the agricultural workers.

Table 16. Efficacy of rodenticides in houses, shopes and godowns

Rodenticides	No. of locations treated	Days of exposure	% rodenticides consumed	Days required for effective control
Zinc phosphide(2%) (after pre-baiting)	15	2 2	19.16	1-2
Bromadiolone cake (0.005%)	15	3	37.36	No effective control
Difethialone (25 ppm)	15	2	45.51	4 - 10
Racumin (0.0375%)	15	2	46.23	3-9
Racumin + Difethialone	15	2	29.31+27.26	3-9
Bromadiolone + Difethialone	15	2	12.39+42.45	4-11
Racumin+ Bromadiolone	15	2	46.37+10.61	4-10

Fabrications

Fabrications of 500 nos (200 tubular and 300 octagonal) of maize shellers, 50 nos of PAU design hand wheel hoe and 10 nos of *Citrus* harvesters have been completed.

AGRICULTURAL ECONOMICS AND STATISTICS

Trends of Investment in Research

K.K. Datta and S.B. Singh

The trends of research investment in ICAR Complex for NEH, a time series actual expenditure (plan + non-plan) information was collected from various reports and other published documents of the Complex. The data set was converted into the current (1998-99) constant prices.

It showed that during the period 1976-85, the investment in research decreased substantially. In the next decade (1987-97), the declining trend continued but the rate of decline is less than the previous decade. But the degree of association between investment and time period is weak (R² = 0.2960). Further analysis of allocation of research investment indicated that per year average annual expenditure on staff is about Rs 2.38 lakhs and per project the investment amount is Rs 33.14 lakhs. The trend of investment per staff is decreasing (1.36%), whereas per project it is increasing at an annual rate of 141%.

Dynamics of Agricultural Growth (1975-1997)

S.B. Singh, K.K. Datta, Kh. B. Singh and K.H.N. Vincent

The area put to agricultural use was significantly low in NE states compared to all India level of 46.73 per cent. It was highest in Tripura (22.90 per cent) and lowest in Arunachal Pradesh (2.04 per cent). There was moderate increase in net sown area in most of the NE states during 1975-76 to 1995-96. The cropping pattern in NE states except Sikkim remained highly

specialized in foodgrains.

Compound growth rate of major crops in different states of north-eastern region during 1975-76 to 1997-98 showed that in case of rice, there was significant growth in area in Arunachal Pradesh and Nagaland while in other states showed negative growth rates. Mizoram experienced the highest growth rate of 7.5 per cent per annum mostly by increasing productivity.

Compound growth rate of major horticultural crops in different states of north-east region during 1975-76 to 1997-98 revealed that production of pineapple in NE states except Manipur increased significantly during a short span of 7 years (1990 to 1997).

The production of milk increased significantly in all NE states with highest growth was reported in Mizoram (21.6%), followed by Nagaland (19.40%), Tripura (5.83%), Sikkim (3.88%), Arunachal Pradesh (1.47%) and Manipur (1.45%). There was significant gain in egg production in NE states. Out of 7 states, 4 sates, viz., Nagaland, Mizoram, Manipur and Meghalaya increased at a growth rate more than all India average of 6.16% per annum. The fish production in NE states could increase significantly in 3 states, viz. Arunachal Pradesh, Manipur and Meghalaya

TRANSFER OF TECHNOLOGY

Extension activities

The technologies developed at ICAR Research Complex, Umiam were taken to farmer through Extension Division by conducting demonstration, VT, OFR, OFT. To increase the knowledge and adoption level, training, field and, farm visits, exhibition, etc. were organized at Umiam as well as at farmer's field.

Verification trials

Different verification trials on paddy, maize and vegetables have been conducted to assess the suitability in farmer's field of Meghalaya. The details have been shown below:

Crop	Variety	Yield (g/ha)	Village	No. of farmers
Cereals	Elizabeth Control			
Paddy	RCPL-1-87-8	34.7	Mawbri	15
Maize	Vijaya	43.4	Mawlasnai	20
	composite			
Vegetables				
Tomato	Rupali	162	Mawlasnai	15
Capsicum	California	151	Umroi	20
	wonder		Labansaro	

Training

The following training programmes have been organized during 2000-2001 for the farmers and farm women as per their requirement.

Field day/Farmer's day

Seven field days/ farmer's day have been observed on different crops viz. paddy, maize, tomato, capsicum and livestock in different adopted villages, where approximately 400 farmers participated.

Kisan mela

Kisan mela was organized on 16th September, 2000 at ICAR Research Complex headquarter which was inaugurated by Hon'ble Chief Minister of Meghalaya. Hon'ble Minister of Agriculture of Meghalaya and Director of Agriculture, Govt. of Meghalaya were also present in this auspicious ceremony. More than 560 farmers participated in the kisan mela.

Technology assessed and transferred

N.D Verma, N. Prakash, P.P. Pal, Rajesh Kumar, S. Naskar, K. Vinod, R.K.P. Singh and G.K. Upamanyu

Technology assessment and refinement through institute village linkage programme

This has been implemented with the aim of identifying production system as assessing performance of modern technologies which in turn will improve the production potentiality of different agricultural crops, livestock etc. The performance when judged against performance indicator clearly shows the adaptability and acceptability of the technologies in farmer's field. The results of intervention on assessment of pedal paddy thresher shows the greater grain output capacity as compared to manual threshing as well as ease in operation by reducing drudgery.

Now the farmers of the project area are adequately skilled and knowledgeable about the modern farming, which has been possible through imparting of training in required aspects. With regard to socio-economic impact analysis of the intervened technologies for the small production system, the common farmers of the project area have observed the adoption of all the technologies. The performance of improved variety of rice in low land condition had resulted that RCPL-1-87-8 had average yield of 31.4q/ha, whereas the local Manipuri variety had yielded only 24 q/ha.

Name of the training programme	Date	No. of pa	No. of participants	
		Male	Female	
Rabbit production technology	4th-6th May, 2000	27	7	
Pig production technology	25th-27th May, 2000	35	11	
Poultry production technology	28th -30th June, 2000	13 104 139	0	
Orientation programme on rice production technology	18th -2nd July, 2000	5	21/201	
Mushroom cultivation	8th -10th August, 2000	10	10	
Training on piggery	5th -7th Sept., 2000	15	11	
Citrus production technology and management	21st -25th Nov, 2000	5	5	



Verification trial of late sown paddy in farmer's field

The Vijaya composite variety of maize exhibited 42.3q yield per hectare. While, the performance of Indo-American hybrid variety of tomato in the existing micro farming situation during *kharif* season showed that variety Rupali had yielded 135q/ha, and Vaishali and Local Khasi variety had given 121 and 56 q yield per hectare, respectively. Similarly the performance of high yielding variety of *Capsicum* showed that variety of California wonder given 134 q yield per hectare against 69q/ha of local variety.

Assessment of potentiality of mushroom spawn (oyster mushroom) in the prevailing micro-farming situation, indicated that that the yield of *Pleurotus sajorcaju* was 518q/ha and *Pleurotus flabellatus* had yielded only 456 q/ha. While, the assessment of performance of improved breed of pigs (87.5% Hampshire inheritance) in the existing micro-farming situation of pig rearing had attained average weight of 6.83 kg against only 4.5 kg by local pig. Assessment of efficiency of pedal paddy thresher had shown that the threshing with pedal paddy thresher gives 42.75 kg grain per hr in contrast to 18.25 kg grain per hr with manual threshing.

FARMING SYSTEM RESEARCH

N. D. Verma (Leader), K. K. Satapathy (Coordinator), K. A. Pathak, B. Mazumdar, J.M.S. Tomar, Basanta Singh, J. L. Singh, R. K. Singh and S.C. Giri

Dairy Based Farming System (FS W1)

Dairy based farming system, was designed on 0.94 ha land (class VI e and VII e) having 32.02% slope in the year 1983 to utilize the maximum local resources and to meet the requirement of a farmer residing near by city as an alternative of shifting cultivation. After development, the area under terraces (0.225ha) is used for production of annual fodder and risers (0.47 ha), trenches (0.095 ha), bunds (0.013 ha) and rocky land (0.14 ha) are utilized for the production of perennial fodder to get fodder throughout the year. Contour trenches were made at 1.5 m vertical as a conservation aid for retaining water within the area. The annual fodder such as maize, soybean and rice bean were grown in 1083 sq m terraced land in lower part of the watershed in kharif season during the year to study the yield potential of rice bean (156.63 g/ha) and maize (117.65 g/ha). In addition to fodder, 22.26 q/ha grain was also produced from the maize crop. The fodder of

soyabean and rice bean was recorded at pod formation stage to get maximum protein rich fodder. A total 17.24 q fodder and 0.84q maize grain were produced on 1083 sq m terraced land in kharif season during the year after 15 years of continuous fodder production. The perennial fodder such as guinea grass and broom grass planted on 0.16 and 0.60 ha land produced 52.99 q (in four cuttings) and 212 52 q fodder respectively during the year after 15 years of continuous fodder cutting. The average productivity of the guinea grass and broom grass were 331.21 q/ha and 354.20 q/ha respectively. In the soybean (Var: JS -80-21) the maximum of 10.55 per cent of the leaves were found damaged by leaf folders. Other pests recorded were stem fly, fea beetles, aphids and blister beetle. For rice bean (Var: RCRB 1-6), leaf folder (Nacolia vulgalis, N dimenalis) damage was found upto 10.35%. Other pests recorded were blister beetle and pod boring weevil (Apion clavipes) Cob borer (Stenachroia elongella) damage was recorded upto 20 per cent at maturity stage and 30% at harvest in maize (Var. RCM, 1-1)

Mixed forestry (FS W2)

Monitoring of insect pests of Alder (Alnus nepalensis), Ex- bucklendia (Simingtonia populnea) and Titachampa (Michelia oblonga) was done at weekly interval throughout the year. Alder was found infested with aphids severely till leaf fall. Incidence started during the month of November and reached a peak during third week of February (108.96 aphids/leaf in 1999-2000 and 176.10/leaf during 2000-2001) and receded during third week of April before leaf fall. A species of Chrysopa larvae were found feeding on aphids in the months of February-March

Silvipastoral system (FS W3)

On a 32% hill slope, Simingtonia populnea, Ficus ariculata and Bauhinia sper as silvi components and branchiaria ruziensis and thysanokeaena maxima as herbcaeous component formed the silvo pastoral system in

an area of 0.90 hectare. S. populnea produced 3.5 t/ha broom grass, 4.5 t/ha and congosignal grass 1.6 green fodder besides native grasses. In this watershed Simingtonia populnea, Bauhinia spp., Ficus auriculata, conga signal grass (Brachriaria ruziensis) and broom grass (Thysanolaena maxima) were monitored for incidence of pest complex. No significant insect grass hopper and blister beetles. During the reported period, there were 30 nos of goat FSW3 and FSW5 (20 nos. and 10 nos. respectively) out of which 11 adult does, 13 female kids and growers, 6 male kids and 2 adult bucks. There were 10 kidding during the year, which gave birth to 18 nos of kids (10 male and 8 female). Five nos of kids died within one week of age due to pneumonia and at weak birth. All the goats were fallowed to graze in different watersheds during Nov. to March and in rest part of the year were provided with sufficient amount of grasses. During winter when grass was not available, the goats were fed with tree leaves like ficus and simingtonia along with broom. Besides this, all the goats were fed with 100 gms of concentrates/ day on an average. Six nos of male kids were castrated at the age of two and half months by burdizzo-castrator method and there growth performances were evaluated by recording body weight at regular intervals. At the age of 6 months, they were slaughtered and evaluations of carcass were done. It was found that the dressing percentage various from 44- 48% of live wt.

Agropastoral system (FS W4)

Agropastoral system was designed on 0.58 ha micro watershed having 32% slope to utilize the maximum local resources and to meet the food requirement of a nucleus family (two adult and three children). Terracing resulted in 0.49 ha land under terraces which was used for production of field crops and 0.33 ha land under terrace risers used for production of perennial fodder such as maize in pre-kharif/kharif season and mustard in rabi season during the year 2000 under semi-organic farming to study the production behaviour of different field crops on

terraced land and also its yield affected by grasses on the risers, terrace width, mulching and to evaluate the different cropping system after 15 years of continuous cropping. The crops such as maize, groundnut, soybean, ginger and ragi performed very well under semi- organic farming after 15 years of continuous cropping and the average productivity of the crops was 29.77, 22.31, 14.46, 14.46, 187.38 and 7.93 q/ ha respectively. Short duration crops such as mustard var. M- 27 grown as a rainfed crop after harvest of maize, ground nut and soybean also performed very well when the crop is sown in the month of September. Productivity of the mustard was high (5.09 q/ha) in soybean, groundnut cropping system as compared with maize mustard cropping system (3.67 q/ha). The productivity of soybean, groundnut, ragi, popcorn and maize was much affected by width of the terraces and grasses on the terrace risers. Front portion of the terraces having 1-1.5 m width produce more yield as compared with mid and back portion of the terraces (having 0.5 m width). Grasses on the terrace risers affects the yield of the crop grown on the terraces but it stabilize the terrace risers and produce forage for cattle without any extra input. Ginger being a shade -loving crop does not get affected by width of the terrace and grasses on the risers. Ragi has been found to be good competitor due to its good root system and establish very fast after transplanting. Cob borer (S. elongella) damage was found upto 16.33 percent and 5-6 larvae per infested cob in maize (RCM, 1-3). While, cob borer damage at harvest recorded was 26.66 per cent in popcorn (RCM, 1-2). Ginger (Var: Nadia) sown on 18-4-2000 was found to be damaged by weevil (prodioctes haenaticus Chev). The leaf damage upto 25.55 percent was found during the month of June. Incidence of stem borer (P. haematicus) damage upto 10.34 per cent was recorded during 2.66/plant damage by weevil (Mylocerous verities), Groundnut (Var: PR ICGS-76 was recorded infestations of leaf folder (N. vulgalis, N. dimenalis) and lower beetles (Mylabris spp.)

Agri horti silvipastoral system (FS W5)

The total area under this watershed is 1.03 ha. Out of this, 0.33 ha is planted with horticulture and agriculture crops, respectively the remaining area was under the tree crops. Thysanolanea maxima was planted with Alnus napalensis, simingtonia populnea and ficus auriculata for fodder purpose. After 12 years of planting the maximum height dbh and volume were recorded by alnus napalensis (9.56 m. 44cm and 113.34 m 3/ha) auriculata (4.93 m,32.66 cm and 32.41 m3 ha -1). The green fodder production was 53.68 qt.ha -1, 28.75 qt.ha -1 and 15.24 qt.ha-1) in the under storey of Alnus nepalensis, simingtonia populnea and ficus auriculata, respectively in addition to 300 qt ha from thysanolaena populnea. Cob borer incidence was observed on maize variety RCM 1-1 upto 30 percent at maturity and 36.67 per cent at harvest. Groundnut Var: ICGS-76 was recorded infestations by leaf folder (N. vulgalis, N. dimenalis) and flower beetles (Mylabrid s spp.). In rice bean Var. RCRB 1-6 was infested with leaf folder and flower beetle Mylabris pustulata. Leaf folder damage was found 36.67 per cent and the beetle's population on flower was 78.89 per 100 plant in September. In soybean leaf folder damage upto 20% was found during the third and fourth week of August. The leaf miner (Phyllocnistis citrella) infestation was recorded in Assam lemon and the maximum infestation of 97.52 per cent was observed during the month of August. In Khasi mandarin leaf miner (P. citrella) maximum infestation (94.66 per cent) was recorded during August. Infestation by termites and trunk borer was recorded during the September revealed 100 per cent infestation of termites and 20 per cent infestation by trunk borer. Application of chlorpryphos@ 5 ml/l drenching an injecting monocrotophos @ 2 ml/l reduced the infestation of termite and trunk borer, respectively. In Alder, similar pattern of aphid infestations was found on alder plants as observed in the watershed No 2 i.e 111.76/leaf during the third week of February.

Silvihorticulture system (FS W6)

The area of the micro watershed was 1.02 ha. Alder was planted in upper 50% portion of the micro watershed. The middle was under horticulture. Lower portion of the system was used for the cultivation of cash crop viz ginger, turmeric and vegetables. After 8th year of planting, average height, basal girth and dbh of Alder was 10.08 m, 24.86 cm and 21.36 cm, respectively. Assam lemon showed production of 10 kg fruits/tree whereas, production of ginger and turmeric was recorded 47.75 q/ha and 70.0 q/ha respectively.

In ginger variety, Nadia stem borer (*P. haematicus*) infestation was found upto 8.33 per cent and turmeric (Var: RCT-1) was free from insect pests. In citrus leaf miner (*P. citrella*) damage was upto 95.59 per cent during second week of August on Assam lemon and 95.67 per cent in case of *Khasi* mandarin. Similar pattern of aphid infestations was found on alder plants as observed in the watershed no II. Infestation of Alder aphids was maximum 112.92/leaf during the third week of February.

Natural fallow (FS W7)

In the 17th year of protection from biotic pressure the natural regenerated pine forest (*Pinus kesia*) has developed a luxuriant growth and dense canopy with 400 trees ha -1. The watershed was dominated by the common weed flora viz *eupatorium adenophorum*, *arundinella bengallensis*, *solanum khasianum* and *ageratum* species. As a result of good under growth and tree stand, there was no runoff and base flow from the watershed.

Timber forestry (FS W8)

Michelia champaka was planted on micro watershed with 41% slope under the high density (1600 plant ha⁻¹) plantation concept. The morphological observation after 9th year of plantation revealed that there was marked changes in growth habits of the plants across the hill slopes with variation in the soil depth.

Michelia champaka leaves and twigs were

heavily infested by bugs (*Urostyles punctigera*). The leaves were also skeletonzed by chrysomelid beetles (unidentified). Infestation of the bugs started from the month of March on new flush and continued upto October. Maximum population of the bug was observed during the months of August to October. Incidence of the adult beetles started in the month of May and continued upto October. Maximum number of beetles196/10 plants (5twigs/plant) were recorded during May.

Hydrological evaluation of different farming systems

Hydrological behaviour of experimental watersheds in terms of total water yields, base flow, surface flow (runoff) and peak flow have been studied. The hydrological data of each experimental watershed were recorded. Total water yield ranges from a maximum of 64.14 mm from AEW 1, followed by 44.21 mm from FS W2 to a minimum of 8.58 mm from FS W7 against annual rainfall of 2652.6 mm. No flow data was recorded from FSW1 and FS W8. Water yield as base flow was recorded only from four experimental watersheds. AEW 1, FS W2, FS W3, and FS W6 with 51.89, 30.31, 9.41 and 6.54 mm, respectively. Soil loss from each watershed was in traces and within permissible limit.

Influence of different farming systems on soil fertility

The investigation was carried out to evaluate the effect of these farming systems on soil fertility build up after 17 years of their continuous adoption under rainfed condition. Surface (0-20cm) soil samples were collected from three slope portion (top, middle and bottom) in each micro watersheds which were air dried, processed and analysed for pH, organic carbon, available N, P, K, S, exchangeable Ca, Mg, K and Al.

The soil pH decreased in all the farming system except agriculture (FSW-4) block. The organic carbon content increased in all the systems and maximum accumulation was found under shifting cultivation (FSW-8), followed by

forestry, horticulture, agri-horti-silvi-pastoral, natural fallow and agriculture land use system. Maximum accumulation of organic carbon under FSW-8 may be because of continuous growth of broom grass (pasture) which is known to be a great accumulator of organic carbon. The systems FSW-1 (livestock land use), FSW-4 (agriculture), FSW-5(agri-horti-silvi-pastoral) and FSW-6 (horticulture), where organic manuring is done, resulted in better built up of available P, K, exchangeable Ca and Mg as compared to other systems receiving no manure. Maximum accumulation of exchangeable cations was recorded in FSW-4, followed by FSW-5 and FSW-6. Available P in the soil varied greatly among different systems and highest accumulation was recorded in FSW-4, followed by FSW-1, FSW-5 and FSW-6. All the systems except FSW-1 maintained a high level of S content in the soil. The overall fertility pattern followed the trend as FSW-4 > FSW-5 > FSW-6 > FSW1 and agriculture based land use system was the most sustainable farming systems regarding soil fertility build up (Table 17 & 18)

Economics of micro-watershed based farming systems

In order to find out the financial feasibility and viability for adoption on the existing farming practices, input-output analysis was carried out for three promising farming systems, FSW-1, FSW-4 and FSW-5 and are presented in

Table 17. Effect of different farming systems on different soil properties

Characteristics	toler in	WILE STREET	MARKET T	Micro wa	tersheds	A Internet	PO SEUSIL	A to also
	FSW-1	FSW-2	FSW-3	FSW-4	FSW-5	FSW-6	FSW-7	FSW-8
pH (1:2.5)	4.65	4.41	4.52	5.03	4.92	4.91	4.99	4.76
Organic C (%)	2.70	2.87	2.61	2.66	2.97	2.97	2.94	3.42
Exchangeable K [cmol (p+)/kg]	0.248	0.274	0.250	0.359	0.417	0.679	0.408	0.326
Exchangeable Ca [cmol (p+)/kg]	1.68	0.59	1.25	3.61	2.11	2.00	1.96	1.57
Exchangeable Mg [cmol (p+)/kg]	0.65	0.30	0.43	2.29	1.45	0.85	0.55	0.38
Exchangeable Al								
[cmol (p+)/kg]	1.25	1.53	1.56	0.46	0.90	0.90	0.88	1.30
Available N (ppm)	221.1	253.8	214.5	233.3	220.3	210.9	179.2	251.1
Available P (ppm)	18.3	5.1	2.1	19.5	16.6	12.9	1.9	2.0
Available K (ppm)	97.1	109.5	98.0	135.1	126.7	265.0	175.6	130.8
Available S (ppm)	6.2	9.3	10.4	15.5	19.9	12.9	14.5	14.8

Table 18. Nutrient balance after 17 years in different farming systems

Characteristics	Micro watersheds							
	FSW-1	FSW-2	FSW-3	FSW-4	FSW-5	FSW-6	FSW-7	FSW-8
Organic C (%)	0.99	1.25	0.81	1.06	1,15	1.17	1.09	1.52
Available P (kg/ha)	36.24	3.58	1.50	39.90	30.68	24.64	0.22	0.22
Available K (kg/ha)	58.90	87.60	41.15	169.80	117,80	421.32	222.41	126.56
Exchangeable Ca								
[cmol (p+)/kg]	0.50	-0.31	0.15	2.51	0.91	0.80	0.81	0.41
Exchangeable Mg						P-PISSO		
[cmol (p+)/kg]	0.18	-0.20	-0.77	0.49	0.25	0.25	-0.24	-0.45

Table-19. Agri-horti-silvi-pastoral land use (FS-W5) worked out to be the most profitable farming system with an input-output ratio of 1:1.64, followed by livestock based land use system (FS-W5), and agriculture land use system (FSW-4). Besides, highest input-output ratio, returns over the years also found to be more stable in this system, which suggest that farmers in this region may adopt the system with no risk.

The introduction of livestock component in 1991 in FSW-4 consistently improved the inputoutput ratio with an overall ratio of 1:1.45. It is due to the complementary relationship between the different components. However, per hectare input cost increased significantly due to the introduction of livestock component. The study indicates that micro-watershed based farming system was found to be highly remunerative and sustainable. However, its adoption by the producer farmers would depend upon the availability of resources, institutional support

Table 19. Input-output values for different watersheds of farming system research (Rs/ha)

Water- shed/ year	Input	Output	Profit/ loss	Input- output ratio
FSW-1				
1988	13654.84	16215.28	2560.44	1:1.19
1991	23184.46	37384.05	14199.59	1:1.61
1993	45030.21	93992.84	48960.63	1:2.08
1997	53674.68	93987.65	40312.97	1:1.75
1999	38607.11	38152.70	(-) 454.41	1:0.99
Overall	34830.26	55946.50	21116.24	1:1.61
FSW-4				
1988	15172.98	12207.40	(-) 2965.58	1:0.80
1991	29675.22	50882.00	21206.78	1:1.71
1993	38201.89	78692.11	40490.22	1:2.05
1997	54504.83	64532.67	10027.84	1:1.18
1999	41081.71	51984.15	10902.44	1:1.27
Overall	35727.33	51659.67	15932.34	1:1.45
FSW-5				
1988	8619.87	17464.66	8844.79	1:2.03
1991	10604.26	20942.82	10338.56	1:1.97
1993	11406.72	24468.56	13061.84	1:2.14
1997	28468.27	42250.10	13781.83	1:1.48
1999	17605.73	20340.50	2734.77	1:1.16
Overall	15340.97	25093.33	9752.36	1:1.64

and also, demand and supply structure.

Partial area treatment under Upper Shipra Watershed (USW) development programme

K. K. Satapathy, R. K. Singh, J. L. Singh, D. K. Sonowal and J.M.S. Tomar

USW having 925.64 ha area under Umsning development block in Ri-Bhoi district was selected as study area. Huge data of the watershed was collected through remote sensing and made imagery of the watershed. Ground truthing/verification was done on different aspects, i.e., land use/land cover, soil and slope aspects, geo-hydromorphology, etc. Under USW, an area of about 82.5 hectares approximately was selected for partial area treatment at Mawpun village. The area was subdivided in micro-watersheds and different landuse treatments were imposed in micro-watersheds according to capability class of land. Contour bunding, half moon terrace, bench terrace, grassed waterways were some of the soil conservation measures adopted in microwatersheds. Landuse imposed were agri-hortisilvi-pastoral, horti-silvi, agro-pastoral and low land paddy. Crops such as radish, French bean, groundnut and maize were grown. Horticultural crops such Assam lemon, orange, guava, pear and litchi were planted.

Mushroom

Mushroom house of 8 x 3.5 m² size was constructed with locally available materials and handed over to farmers. Concerned farmers were trained for mushroom cultivation. About 12 kg of mushroom was obtained from 8 cubes in first harvest and same was sold by farmers @Rs 60 per kg.

Fishery

Two numbers of ponds of 1427 m² and 1135m² area with 2 m depth was excavated. Bigger pond was divided into two parts by constructing embankment. Rohu, Mrigal, Catla, Commoncarp, Grasscarp, Silvercarp were put in the pond.

Methodologies for development and analysis of watersheds and DSS for interventions (MDAWDSSI)

S.B. Singh; Kh. B. Singh; K.H.N. Vincent and K.K. Datta

MDAWDSSI study was made for 9 completed watersheds in Meghalaya and Manipur. The watersheds were surveyed using pre-tested questionnaire, data tabulated and simple analysis undertaken. Area under wetland paddy cultivation increased substantially in Sukhwai and Maweit watersheds after the watershed project. The area under *jhum* cultivation declined in Sukhwai and Maweit watersheds, while the reverse was true in Maklang watershed.

Area under HYV increased substantially in Sukhwai watershed while the reverse was true in the case of local varieties.

AGROFORESTRY

Collection and evaluation of multipurpose tree species suitable for agroforestry systems (AFS)

B.P. Bhatt

Initially, 9 tree species were evaluated for their growth performance and compatibility in various AFS. Based on screening, 7 species viz. Alnus nepalensis, Parkia roxburghii, Prunus cerasoides, Michelia oblonga, Simingtonia populnea, Gmelia arborea and Pinus kesiya were found suitable for farming in various AFS. The performance of the MPTs was excellent with survival percentage of 70 to 90. The height, diameter and timber volume production varied significantly among the species. However, Parkia roxburghii attained maximum height and dbh (27m, 39.4cm), followed by Michelia oblonga (18.6m, 41.2cm), Gmelia arborea (18.0m, 26.01cm), Wild cherry (16.98m, 24.8cm) and Alnus nepalensis (18.5m, 23.8cm). The mean annual increment (MAI) ranged between 0.952.20m for height growth and 1.76-2.95cm for dbh among the species.

Development of suitable management practices for different AFS with special reference to their productivity and sustainability

B.P. Bhatt and L.K. Misra

Horti-agri system (Guava based AFS)

Guava (Allahabad Safeda) based AFS has shown gradual decrease in production over last three years. The average fruit yield and intercrop yield of turmeric was severely lowered (10t/ha.) as compared to earlier years.

Upland paddy varieties- RCPL-1-24, RCPL-1-25 and RCPL-1-29 was intercropped with guava. Yield of guava fruit was recorded 60.62 q/ha. Among different varieties of paddy, RCPL-1-24 has maximum (42.70 q/ha) production, followed by RCPL-1-29 (33.52 q/ha) and RCPL-1-25 (32.76 q/ha), respectively (Table 20).

Table 20. Production potential of upland paddy with guava (q/ha)

Crop combi- nation	Crop compo- nents	Yield of guava	Rice yield	Yield without trees (control)
Guava + RCPL-1-24	Grain	60.62	42.70	48.23
Guava + RCPL-1-25	Grain	60.62	32.76	41.65
Guava + RCPL-1-29	Grain	60.62	33.52	39.90

Assam lemon with paddy

B.P. Bhatt and J.M.S. Tomar

RCPL-1-24, RCPL-1-25 and RCPL-1-29 upland paddy varieties were intercropped with Assam lemon (cv local). Yield of Assam lemon was recorded 50.0 q/ha. Among different varieties of paddy, RCPL-1-24 has maximum (41.66 q/ha) production, followed by RCPL-1-25

(33.01 q/ha) and RCPL-1-29 (32.91 q/ha), respectively (Table 21).

Table 21. Production potential of upland paddy with Assam lemon (g/ha)

Crop combination	Yield of guava	Rice yield	Yield with- out trees (control)
Assam lemon +RCPL-1-24	50.12	41.66	48.23
Assam lemon			
+RCPL-1-25	50.12	33.01	41.65
Assam lemon			
+ RCPL-1-29	50.12	32.91	39.90

Citrus based AFS

B.P. Bhatt and J.M.S. Tomar

Khasi mandrin (Citrus reticulata Blanco) based AFS has shown its good growth and high yield. Although mandarin fruit yield was lower than that of last year, intercrop performed very well. Turmeric (cv RCT-1) and Colocasia (cv Meghalaya local) were intercropped. Production potential of crop has been shown in Table 22.

Table 22. Growth and productivity of khasi mandarin based AFS

Spacing	Plant height (m)	Plants spread	Fruit yield (kg/ tree)	Turmeric yield (t/ha)	Colocasia yield (t/ha)
5m x 5m	6.10	3.80	36.20	20.14	18.60
2.5 x 2.5	6.32	3.40	18.40	20.87	19.23

Horti-agri-pastoral system

B.P. Bhatt and L.K. Misra

Under this system, one line of each of three grasses, e.g., broom, congo and guinea were transplanted at 5m apart in a mild sloping land and khasi mandarin were planted 5m apart in inter space. Turmeric (RCT-1) was sown as intercrop. The yield of turmeric was 15 t/ha. The yield was comparatively lowered to other shade or partial shade area. Mandarin recorded an average height and spread of 2.7m and 0.98m, respectively, after three year's of plantation. The

green biomass (above ground) yield of broom grass was 64 t/ha including flower. The yield of congo and guinea were 26.7 and 38.4 t/ha, respectively.

Silvipastoral system

B.P. Bhat

In this system, fodder grasses (Congo and guinea) were intercropped with silver oak. After fifth year, silver oak attained an average height of 6.5m and dbh 6.4cm. The yield of fodder grasses, congo (25t/ha) and guinea (30t/ha) were optimum.

Evaluation of multistoried AFS

B.P. Bhatt, J.M.S. Tomar and L.K. Misra

Under this system, one row each of turmeric (cv. RCT-1) and colocasia (cv. Meghalaya local) were sown in terraces along with standing crops of tea on risers and black pepper under the shade of alder tree. Twelve years of observation revealed that alder has positive effects on the production of tea. From the month of April to October, 6400-kg/ha of green buds could be harvested from the systems besides turmeric (18.7 t/ha). Colocasia (18.0 t/ha) and fuelwood (pruned material 9 t/ha). The yield of black pepper (260gm dried/plant) was very poor because black pepper cannot tolerate frost and got damaged, which rejuvenated afterwards. The alder recorded an average height, diameter, and spread of 23m. 26.89cm and 7.9m, respectively (Table 23).

Table 23. Performance of alder and yield of tea and inter-crops under multistoried systems

Component	Growth	Yield
Alder		
Av. Height	23.0 m	
Av. Dbh	26.89cm	Property (Control of Control of C
Av. Plant spread	7.9m	
Tea (Fresh buds)		6.4t/ha
Colocasia*		18.4t/ha
Turmeric*		18.7t/ha
Black pepper (dried)		260g/plant

^{*}One line on each terrace

Studies on post harvest technology, forest utilization, wild life, animal, fishery, apiculture and lac, etc. in relation to agroforestry system

B.P. Bhatt

Detailed studies are yet to be done on this aspect. However, Som (Machilus bombycina) based AFS has been developed and under this system, agricultural crops turmeric (Cv RCT-1) and ginger (cv. Nadia) were sown in terrace with standing crop of broom grass in risers. Som was planted at a spacing of 6m x 4m. After seven years, the plants attained a height, diameter and spread of 7.0m, 10.9cm and 3.45m, respectively. Broom grass was harvested twice as fodder before allowing it for flowering. A total yield of 54 t/ha green fodder including 1.7t/ha flower was obtained from broom grass. The yield of turmeric and ginger was 19.5 t/ha and 17.6 t/ha, respectively.

Improvement of suitable tree species through selection

B.P. Bhatt and J.M.S. Tomar

During last year 14 genotypes of alder were tried for evaluation but the success was not found. Now we have planned to conduct provenance-progeny trial in *Pinus kesiya*, *Alnus nepalensis* and *Gmelina arborea*. However, work is in progress for genetic evaluation of *Parkia roxburghii*. About 14 provenances are being evaluated and the results are yet to be explored.

Besides selection in indigenous MPTs, clonal selection in *Populus deltoides* is being tried. In all 43 clones were collected from FRI, Dehradun, Uttaranchal. After one year's survival and growth performance, it has been recorded that clone PIP-201, PIP-117, PIP-213, PIP-206 and PIP-113 are suitable, keeping in view their survival and growth performance. Further multiplication and site adaptability trial of aforesaid promising clones is in progress.

Economics of potential AFS

S.B. Singh, L. K. Misra and K.K. Datta

Experimental data were collected during 1987 to 1999 on AFS consisting of two fruit trees *viz.*, mandarin and guava in combination with different crop rotations, *viz.*, soybean, ground-nut, turmeric and ginger. The Net Present Value (NPV), Benefit-cost Ratio (B-C), payback period and Internal Rate of Return (IRR) have been computed for financial analysis. A discount rate of 18 per cent was used in presenting results and the inputs were valued at the market price of 1999-2000. The per ha cost of planting mandarin based AFS was worked out to be Rs. 31,210 for soybean, Rs 32,877 for groundnut, Rs. 45,627 for turmeric and Rs. 44,745 for ginger, respectively, and same for guava based AFS.

The net benefit streams under Mandarin and Guava based AFS was also evaluated. Mandarin based AFS incline profitability from seven year onwards and remain highly remunerative beyond 13 year. However, for guava based AFS, the trend reached maximum at sixth year, then gradually decline and become un-remunerative between 12th to 13th year. It indicates that practice of the system should not go beyond 12 year.

Under mandarin-based AFS, all the systems were profitable at 18 per cent discount rate. Madarin+ginger+french bean system worked out to be most profitable with benefit-cost ratio of (2.58), followed by mandarin+turmeric +french bean (2.54), and mandarin+sovabean system (2.48). Mandarin+groundnut system being least profitable with B-C ratio of (2.35). The net present value (NPV) varied from Rs. 2,27,854 in Mandarin+groundnut to Rs. 3,71,449 in Mandarin+ginger+french bean system. The pay back period criterion also indicated whole cost of systems can be recovered within 1 to 2 years in case of Mandarin + ginger+french bean and turmeric systems, whereas it takes 7 to 8 years in case of Mandarin+soyabean and groundnut systems.

Similarly, in case of guava based AFS, Guava+ginger+french bean was found to be most profitable and Guava+groundnut system being least profitable. Comparison of the two systems showed that mandarin based AFS was more profitable from farmer's point of view, indicated by highly benefit-cost ratio and NPV. The lower payback period in case of guava based AFS is due to earlier fruiting of guava as compared to mandarin.

VISITORS

Distinguish Visitors

- Dr. S.S. Ghosh, Dy. Director General (Hort),
 Dr. G.L. Kaul, Vice-Chancellor, AAU, Assam,
 Dr. S.S. Baghel, VC, CAU, Imphal, Dr. Shyam
 Singh, Director, NRC on Citrus, Nagpur & Dr.
 R.C. Upadhyaya, Director, NRC on Orchid,
 Sikkim visited the complex in connection
 with the Citrus Decline Workshop.
- Dr. M. Bhattacharjee, Vice-Chancellor, Assam University, Silchar visited the complex on 15.9.2000.

- Shri. E.K. Mawlong, honourable Chief Minister of Meghalaya visited the complex on 16.9.2000.
- Shri. B.K. Sangma, honourable Agricultural Minister of Meghalaya visited the complex on 16.9.2000
- Dr. A.K. Rai, Inharge Director, Atomic Energy, Shillong visited the complex on 14.9.2000.
- Shri. Bhaskar Barua, Secretary, Agriculture and Co-Operation, Govt. of India visited ICAR Complex, Umiam on 8th July 2000.
- Dr. K.C. Bhardwaj, Principal Investigator, NATP on "Prototype Manufacturing of Agricultural Implements" and P.S. CIAE, Bhopal visited this complex during 4-8 December 2000 to review the progress of the NATP.
- Shri. L.A. Sangma, Hon'ble Minister of Planning, Govt. of Meghalaya visited the complex on 10th November 2000.
- Dr. L.S. Rathore, Head, Application Division and Dr. A.K. Bohra, Head, Computer Division, National Centre for Medium Range Weather Forecasting (NCMRWF), Department of Science & Technology, New Delhi visited the complex from 11th to 13th December, 2000



Visit of Shri Bhaskar Barua, Secretary, Agriculture and Co-Operation, Govt. of India to ICAR farm

to inspect the Agroment Observatory of the complex as well as the performance Agroment Advisory Service running in the division.

 Dr. B.R. Sharma, ADG (IWM), NRM visited the complex on 17th January, 2001.

Other Visitors

- Twenty-five members of Diocegan Social Forum, Guwahati visited the complex on 5th October, 2000.
- Twenty-three Officers from NIRD, Guwahati visited the complex on 8.11.2000
- Twenty-one of Nagaland Centenary Mission Society, Kohima visited the complex on 27.11.2000.
- 67 Students from Eden Academy, English Medium School, Umsning visited the complex on 28.11.2000.
- Sixty-one Bosco Reach out (NGO) Smit Region, Mawlyng area visited the complex on 30th November, 2000.
- Sixty students of Monbhut Memorial High School, Mairang Laitdon, West Khasi Hills visited the complex on 12th December, 2000.
- 25 students from Jawaharlal Nehru College, Boko District, Kamrup (Assam) visited the complex on 6.1. 2000.
- 08 Farmers from Arunachal Pradesh visited the complex on 25. 1. 2001.
- Opinion Leaders (16 Nos.) from Uttar Pradesh visited the complex on 27.2.2001.
- 20 Participants of Assam Soil Conservation Training School, Guwahati visited the Complex on 13.3.2001.
- 14 Participants of SIRD, Nongsder visited the complex on 16.3.2001.
- A Team of PIB, headed by DDPIB, Lucknow visited the complex on 19.3.2001.
- 31 Trainees from karbi Anglong, Assam visited the complex on 27.3.2001.

4 PUBLICATIONS

Research Papers Published in Journals

- Bandopadhayay, S. and Singh, B.P. 2000. Antibody response in secondary hydatidosis by ELISA using affinity purified buffalo hydatid cyst fluid antigen. J. Vet. Parasitology, 14(1): 17-20.
- Bhatt, B.P. and Chauhan, D.S. 2000. Allelopathic effects of *Quercus* spp. on crops of Garhwal Himalaya. *Allelopathy Journal*, 7(2): 265-272.
- Chauhan, D.S.; Bhatt, B.P. and Todaria, N.P. 2000. Rooting response of *Desmodium elegans* as influenced by auxin, rooting medium, kind and source of cuttings. *J. Trop. Forest Science*, 12(4): 733-743.
- Das, S. K.; Sarkar, A.B.; Bujarbaruah, K.M. and Rajkhowa, C. 2001. Morbidity and mortality of rabbit as influenced by housing, space, breed and season by performance of local rabbit on different roughage feeding. *Indian Vet. J.*, 78(1): 30-35.
- Datta, K.K and Bhu Dyal 2000. Irrigation with poor quality water: An empirical study of input Use, economic loss, and copping strategies. *Indian J. of Agril. Econ.*, 55(1): 26-38.
- Datta, K.K.; de, Jong, C and Singh, O.P. 2000. Reclaiming salt-affected land through drainage in Haryana, India: a financial analysis. Agril. Water Mgmt., 46(1): 55-71.
- Goswami, S.N. and Singh, S.N. 2000. Problems and prospects of marketing of horticultural crops in North-East India. *Agril. Marketing*, XLIII(I): 23-30

- Goswami, S.N.; Singh, S.B. and Sarma, B.K. 2000. Energy use pattern in rural tribal households . In: *Renewable Energy and its Management*. Reliance Publishing House, New Delhi, pp 133-145.
- Kumar, Ashok.; Agarwal, R. K.; Bhilegaonkar, K. N.; Shome, B. R. and Bachhil, V. N. 2001. Occurrence of Campylobacter jejuni in vegetables. Int. J. Food Microbiol., 67: 153-155.
- Hazarika, U.K; Munda, G.C.; Singh, N.P. and Panwar, A.S. 2000. Azolla: A natural biofertiliser for transplanted rice. Journal of NEC, 20(3): 25-28.
- Lal, B.; Majumdar, B. and Venkatesh, M.S. 2000. Individual and Interactive effects of phosphorus and zinc in low land rice. *Indian J. Hill. Farmg.*, 13(1-2): 44-46.
- Laxminarayan, K. and Verma, D.K. 2000. Diversified uses of maize (in Mizo). Zoram Loneitu, 42: 32-35.
- Mandal, S.S.; Akhtar, S.A. and Verma, D.K. 2000. Knob pattern and its relationship with quantitative characters in maize: a review. Agric. Rev., 21: 97-103.
- Mishra, A.K.; Gupta, S.K.; Jeena, S.K. and Agarwal, K.N. 2000. Prospects of microirrigation in North Eastern Region of India. *Journal of the North Eastern Council*, 20(3): 3-13.
- Pal, P.P.; Prakash, N.; Kumar, Rajesh and Thakur, P.K. 2000; An overall evaluation of performance of summer institute on sustainable hill agriculture. J. of Extension Education, 2: 2802-2804.

- Patel, D.P. Munda, G.C. and Singh, N.P. 2001: Groundnut Technology for increasing productivity in NEH region. *Journal of NEC*, 21(1): 18-22.
- Patel, D.P. and Munda, G.C. 2001: Growth pattern and yield potential of some promising cultivars of blackgram (Vigna mungo, L) under rainfed mid hills of Meghalaya. Crop Research, 21(2): 130-133.
- Patel, D.P.; Munda, G.C. and N.P. Singh 2000. French bean technology for increasing productivity in NEH Region. *Journal of NEC*, 20(4): 3-6.
- Pattanayak, A. and Gupta, H.S. 2000. Evaluation of anther culture-derived lines under upland conditions of North Eastern Hill of India. *IRRN*, 25: 9 10.
- Pattanayak, A.; Bhuyan, R.N.; Gupta, H.S., Sreedhar, M. and Prasad, M.S. 2000. Performance of cold tolerant rice lines developed through anther culture for mid altitude areas of Meghalaya, India. IRRN, 25: 11 – 12.
- Pattanayk, A.; Anna Durai, A., Singh, J.K. and Sarma, B.K. 2000. Preliminary evaluation of some exotic rice germplasm. *Indian J. Hill Farmg.*, 13: 100-104.
- Poonam, Mandal, S.S.; Kumar, N. and Verma, D.K. 2000. Quality indices in rice: A review. *Agric. Rev.*, 21(3): 178-185.
- Roy, B.C. and Datta, K.K. 2000. Rice-wheat system in Haryana: Priotrizing production constraints and implication for future research. *Indian J. of Agril. Econ.*, 55: 671-682.
- Sahoo, S.K.; Yadav, B.P.S.; Gupta, J.J. and Gupta, H.K. 2000. Performance of goat fed exbucklandia (Symingtonia populnea) leaves. Indian J. Anim. Nutr., 17(4): 336-338.
- Santha Lakshmi; B., Gupta, J.P. and Prasad, M.S. 2000. Translocation of systemic fungicide thiophanate-methyl in soybean plants. *Indian Phytopathology*, 53(1): 87-91.

- Sarma, B.K. and Pattanayak, A. 2000. Farm and rural broadcast in All India Radio: an overview. *Prasiskhyan*, 1: 2-3.
- Sarma, B.K. and Sharma, U.C. 2000. Agriculture of the *Lakhers* of Mizoram. Asian Agri-History, 4: 21-30.
- Sarma, B.K.; Singh, Janak K.; Verma, D.K.; Anna Durai; Pattanayak, A. and Laxminarayana, K. 2000. Collecting crop diversity from northeast India. J. Assam Agr. Soc., 41(4): 326-335.
- Shome, B. R.; Shome, Rajeswari.; Ahlawat, S. P.S. and Verma, N. D. 2000. Agar depolymerizing (agarolytic) bacteria isolated from mangrove soil samples of Andaman. Curr. Sci. 79(6): 696-697.
- Shome, B. R.; Padhi, M. K.; Shome, Rajeswari.; Senani, S.; Saha, S. K. and Rai, R. B. 2000. Ascites complex in indigenous Naked Neck poultry birds of Andaman. *Indian Vet.* J., 77: 801-802.
- Shome, Rajeswari.;, Shome, B. R.; Senani, S., Padhi, M. K.; Saha, S. K.; Rai, R. B.; Kumar, A.; Verma, N. D. and Ahlawat, S. P. S. 2000. Acute opthalmitis in poultry: etiological and control studies. *Indian J. Poult. Sci.*, 35(3): 355-356.
- Shome, Rajeswari.; Shome, B. R.; Gaur, K. K.; and Senani, S. 2001. Plasmids of Aeromonas hydrophila isolated from fresh water fishes. Ind. J. of Fisheries, 48(1): 109-110.
- Singh N.P.; Promod Kumar and Verma, N.D. 2000. Agro based Industries. A Boon for the shifting cultivation, *Journal of NEC*, 20(4): 38-47.
- Singh, A.K. and Singh, N.D. 2000 Nutrient Management for optimision rice productivity in valley soils of Meghalaya. Fertiliser News, 45(7): 51-53.
- Singh, D.N. and Verma, D.K. 2000. Embry culture in legumes: A review. *Agric. Rev.*, 22(1): 13-24.
- Singh, N.P.; Singh, A.K and Patel, D.P. 2000. Shifting Cultivation and its alternate